

**HAVE WE FORGOTTEN THE CHILDREN?
HEALTH AND NUTRITION ISSUES IN REFUGEE AND IMMIGRANT
NEWCOMER CHILDREN**

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ABSTRACT

The high prevalence of nutrition-related chronic conditions in children and adolescents is an emerging public health problem. Research has shown that newcomers to Canada (<5yrs) are at a greater risk of experiencing health and nutrition issues compared to the Canadian-born. The literature shows newcomers have better health upon arrival than the Canadian-born. However, as their length of stay in the country increases, their health status declines to that of Canadians or even surpasses them. To my knowledge, there has not been a comprehensive study on health and nutrition issues in newcomer children to Canada. Very few studies distinguish refugees from immigrants, even though they are two very different populations. Therefore, the objective of this study was to examine the health and nutrition of newcomer refugee and immigrant children to Canada. Various health indices were examined. Questionnaires were administered to describe demographics, socio-economic status, physical and sedentary activity levels, and food security. Dietary assessments provided information on food group and nutrient intake and allowed us to develop scores based on Canada's Healthy Eating Index. Biomarkers of disease were also examined and included serum vitamin D, total cholesterol, blood glucose, blood pressure, and total body bone mineral content.

Immigrant and refugee children were eligible to participate if they were between the ages of 7-11 years and had been in Canada no more than five years (n=72). Descriptive analyses were conducted for all variables of interest.

The prevalence of food insecurity was much higher in newcomers in this study compared to immigrant children from the Canadian Community Health Survey (CCHS) 2008. In this study, 66% of refugees and 39% of immigrants experienced some form of food insecurity whereas the CCHS 2008 found this value to be only 13%. Food security is directly related to income. The majority of participants in this study were classified in the lowest income category and 72% of refugee and 12% of immigrant children lived in a household where neither parent had a secondary level of education. Food insecurity has a negative impact on nutrient intake and overall health. Results from this study showed that immigrant and refugee newcomer children had a higher rate of overweight/obesity at approximately 29% compared to 26% in Canadian-born children. Participants also had lower mean scores based on Canada's Healthy Eating Index compared to their Canadian-born counterparts. Immigrants consumed a greater amount of

sodium than refugees, however, still lower than Canadians. Low levels of dietary vitamin D and calcium in immigrants and refugees were consistent with a low consumption of milk and alternatives. Immigrants and refugees were also consuming lower amounts of fibre and folate (DFE) compared to Canadians. Other nutrients of concern for refugees included iron and zinc.

Total body bone mineral content of newcomer children was similar to the Canadian-born. Comparing with published data, Canadian-born children had higher serum vitamin D levels than newcomer immigrant and refugee children in this study, 72.5% of whom were vitamin D deficient or had inadequate levels. Blood cholesterol was high in 40% of participants. Blood glucose was high in 7% of participants. In this study, newcomer children, particularly refugee children, were at risk of experiencing negative health outcomes such as higher levels of food insecurity, high prevalence of intake inadequacy of key nutrients, overweight and obesity, and vitamin D deficiency and inadequacy.

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LIST OF ABBREVIATIONS

AI	Adequate Intake
AMDR	Acceptable Macronutrient Distribution Ranges
BMC	Bone Mineral Content
BMD	Bone Mineral Density
BMI	Body Mass Index
CCHS	Canadian Community Health Survey
CHMS	Canadian Health Measures Survey
CIC	Citizenship and Immigration Canada
CPA	Children's Physical Activity
CSEP	Canadian Society for Exercise Physiology
CVD	Cardiovascular Disease
DBP	Diastolic Blood Pressure
DBS	Dried Blood Spot
DFE	Dietary Folate Equivalents
DRI	Dietary Reference Intake
DXA	Dual-Energy X-ray Absorptiometry
EAR	Estimated Average Requirement
FAO	Food and Agriculture Organization of the United Nations
HDL-C	High-Density Lipoprotein Cholesterol
HEI	Healthy Eating Index
HEIC	Canada's Healthy Eating Index
IDC	International Development Committee
IOM	Institute of Medicine
IU	International Unit
LC-MS/MS	Liquid Chromatography Mass Spectrometry
LDL-C	Low-Density Lipoprotein Cholesterol
NHBPEP	National High Blood Pressure Education Program
NHANES	National Health and Nutrition Examination Survey
NPHS	National Population Health Survey

OR	Odds Ratio
PHAC	Public Health Agency of Canada
SBP	Systolic Blood Pressure
SLID	Survey of Labour and Income Dynamics
SINP	Saskatchewan Immigrant Nominee Program
TBBMC	Total Body Bone Mineral Content
UL	Tolerable Upper Intake Level
UNHCR	United Nations High Commissioner for Refugees
USDA	United States Department of Agriculture
WFP	World Food Programme
WHO	World Health Organization

1. INTRODUCTION

1.1 Rationale

We live in a diverse world that consists of many different ethnicities. People migrate as individuals or with their families for multiple reasons including to improve socio-economic status and certain aspects of health, for job opportunities, and, ultimately, a desire for a better life. Developed countries, such as Canada, are often considered more advanced, however, many people who migrate to these countries experience declines in health after a number of years (DesMeules et al., 2004).

Children have a say in what the family eats and newcomer parents more often listen to their children's food recommendations as they assume they should follow the Western ideology (Babington & Patel, 2008). The primary health issues faced by children, our target population, include overweight/obesity and diabetes mellitus, which can progress into the development of other chronic diseases later in life, and nutrient deficiencies including vitamin D and calcium, which are known to contribute to bone health and can prevent the development of osteoporosis (Whiting & Calvo, 2005; Holick, 2011). Further, the association between vitamin D status and different kinds of cancers, multiple sclerosis as well as other health complications is noted in recent literature (Whiting & Calvo, 2005; Holick, 2011).

According to Statistics Canada, 18% of Canadian children and adolescents aged 2-17 years are overweight and 8% are obese (Shields, 2005). Canadian information could not be found in regards to overweight and obesity in immigrants and refugees specifically for the 7-11 years age range. In 2004, 18% of adolescents were already reporting having developed at least one chronic condition (Shields, 2005). The Food and Agriculture Organization of the United Nations (FAO) (2003) states "Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." According to the Canadian Community Health Survey (CCHS) Cycle 2.2, 4.9% of Canadian-born children experienced some form of income-related food insecurity while 5.6% of non-recent (>5 years) immigrant children experienced food insecurity, a number that more than doubles to 12.4% in recent (≤ 5 years) immigrant children (Health Canada, 2007). When there is not enough money for food or traditional foods are not available, families will often buy less food or cheaper food

that contains fewer nutrients and more calories (International Development Committee [IDC], 2008).

Studies suggest health interventions are most beneficial in pre-pubertal children as lifestyle and behaviour changes are most likely to be incorporated into daily living at this age. Such interventions are important not only for their overall health during the critical period of growth, but also for preventing early establishment of chronic conditions that are related to lifestyle factors (Teegarden, Lyle, Proulx, Johnston, & Weaver, 1999; Van Horn et al., 2003). Van Horn et al. (1985) concluded that “...educational and behavioural dietary intervention in children can result in lower consumption of total fat, saturated fat, and cholesterol over 3 years, and maintenance of lower levels of total and saturated fat were observed for an additional 4 years.” Although milk intake decreases from childhood to adolescence, it is important for growth and development as well as achieving peak bone mass, which is the amount of bony tissue at the end of skeletal maturation (Sandler et al., 1985; Teegarden et al., 1999). Since bone mineral decreases with age, research has emphasized the importance of achieving optimal bone mineral accrual during childhood and adolescence, which will decrease skeletal related health issues later in life (Bailey, Faulkner, & McKay, 1996). For example, young women are more likely to have higher calcium intake levels if they consume larger amounts of milk in childhood (Teegarden et al., 1999).

The types of food and beverages children are consuming have an impact on other aspects of health as well. For example, the prevalence of overweight/obesity is on the rise in children (Shields, 2005). Adequate consumption of vegetables and fruit, greater levels of physical activity, and less time spent watching television, playing video games or playing on the computer all decrease the likelihood of developing overweight/obesity in childhood (Shields, 2005). Food insecure Canadian children are consuming fewer servings of vegetables and fruit and milk products compared to those who are food secure (Kirkpatrick & Tarasuk, 2008b). The number of newcomer families with children is on the rise in Saskatoon. These children are likely to face similar health issues as Canadian-born children, yet, the majority of research focuses on newcomer adults. Hence, identifying nutrition and health issues in refugee and immigrant children and implementing well-designed health interventions is imperative in this high risk population.

1.2 Study Objective

To characterize health and nutrition issues that affect immigrant and refugee children who have been in Canada for less than five years.

1.3 Specific Objectives and Hypotheses

1. To characterize the nutritional status of newcomer (≤ 5 years) children and identify the prevalence of inadequate intakes in a selection of important nutrients including vitamin D, calcium, folate (DFE), fibre, vitamin B12, iron, and zinc.

Hypothesis: Newcomer children who have been in Canada for less than five years have poor nutritional status and a high rate of inadequate intake in major nutrients, particularly vitamin D, calcium, and protein and a high rate of sodium intake compared to Canadian-born children. These measures are worse in children of refugee families compared to immigrant children.

2. To evaluate physical activity in newcomer children.

Hypothesis: Newcomer children have a low level of physical activity compared to Canadian-born children.

3. To evaluate serum vitamin D status in newcomer children.

Hypothesis: Newcomer children have inadequate levels of serum vitamin D. This is worse in newcomer children compared to Canadian-born children and in refugee compared to immigrant children.

4. To evaluate income-related household food insecurity of newcomer children's families and its impact on children's nutritional status.

Hypothesis: The nutritional status of newcomer children with household food insecurity will be poor compared to Canadian children.

5. To determine the association between nutrition and physical activity with

overweight/obesity, blood pressure, blood glucose, cholesterol, serum vitamin D, and total body bone mineral content in newcomer children.

Hypothesis: Poor nutritional status and a low level of physical activity in newcomer children are associated with poor health outcomes such as overweight/obesity, high blood pressure, high blood glucose, high cholesterol, vitamin D deficiency and inadequacy, and low total body bone mineral content compared to Canadian-born children.

1.4 Significance

An in depth review of the literature has discovered many gaps in the research in regards to immigrant and refugee children. The majority of studies on health status of immigrants and refugees have focused on adults and few articles are available on those who migrate to Canada. Further, refugees are typically classified under the term immigrant even though these two populations have very different experiences both pre- and post-migration. It is, therefore, important to consider them as two separate groups. Chronic conditions such as obesity, hypertension, and diabetes are becoming more prevalent in children. However, to our knowledge, studies that have shown how certain ethnicities are predisposed to some chronic conditions have only been done in adults. Vitamin D and calcium are important determinants of bone health, the majority of which is accrued during childhood. Some studies do examine bone accrual in children of different ethnicities and I will thus be comparing my results to these studies. Other factors that have an effect on health include food security, nutrient intake, and physical activity levels, all of which were analysed in this study. Research needs to be done in this area as there are an increasing number of immigrants and refugees to Canada and the health of adults has been found to decrease as their length of stay increases.

1.5 Summary

Chronic diseases are no longer a disease found solely in adults. They are beginning to develop and manifest in children. Newcomer children face barriers to food security, healthcare, and integration into a new culture upon arrival to Canada, which might affect their future health status. Nutrition plays an important role in overall health. Research shows that healthy lifestyle

behaviours are best introduced during pre-adolescence as then they are most likely to persist throughout adolescence and adulthood. The present study evaluates health and nutrition issues in refugee and immigrant newcomer children.

2. LITERATURE REVIEW

2.1 *Immigrants and Refugees to Canada*

An immigrant is someone who “comes as a permanent resident to a country other than one’s native land” (The Canadian Oxford Dictionary, 2011). During the 1951 Geneva Convention, the definition of the term refugee was contrived and is still used today by most countries in the world, including Canada (Amnesty International, 2009). A refugee is someone who “...owing to well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion”..., is unable or unwilling to return to his/her country of birth due to fear for their safety (United Nations High Commissioner for Refugees [UNHCR], 1951). Refugees are often included in the term immigrant; however, these two populations are unique due to their different countries of origin, cultures, pre- and post-migration factors, and socio-economic status, all of which affect their quality of life and integration into a new society.

The 2009 United Nations High Commissioner for Refugees (UNHCR) Statistical Yearbook states there are 10.4 million refugees in the world; more than one third of them are living in the Asia and Pacific region, one fifth in Sub-Saharan Africa, 19% in the Middle East, 16% in Europe, and 8% in the Americas (UNHCR, 2009). As of 2008, there were approximately 214 million migrants worldwide of which 7.2 million were in Canada, making it the country with the fifth highest number of international migrants (Cymbal & Bujnowski, 2010). Canada is a desirable place for newcomer immigrants and refugees. There are over 200 different ethnicities in Canada of which 41% state they have more than one ethnic origin (Statistics Canada, 2008a). The majority of immigrants to Canada come from China, India, and the Philippines (Cymbal & Bujnowski, 2010). Newcomers to Canada are classified in four categories including economic immigrants, family class immigrants, refugees, and others (Cymbal & Bujnowski, 2010). The economic immigrants comprise those who can contribute to the Canadian economy as well as spouses and dependents (Health Canada, 2010a). The family class consists of those who are sponsored by adult family members who are Canadian-born or already permanent residents (Health Canada, 2010a). Refugees are government-assisted or privately sponsored refugees and their dependents (Health Canada, 2010a). The other category comprises people who come on

their own or are in Canada temporarily (Cymbal & Bujnowski, 2010). The majority of immigrants come to Canada under either the economic or family class (Cymbal & Bujnowski, 2010). In 2008, 247,243 immigrants settled in Canada, of which 21,860 were refugees (Government of Saskatchewan, 2008).

The top three source countries of immigrants to Saskatchewan are the Philippines, China, and the United Kingdom (Government of Saskatchewan, 2008). The Saskatchewan Immigrant Nominee Program (SINP) accelerates the immigration process and was responsible for bringing 3,000 newcomers to the province in 2008 (Government of Saskatchewan, 2008). To qualify for the SINP, you must meet requirements of one of three categories, which are family, employment, or education (Government of Saskatchewan, 2011). Applicants must also go through health, criminality, and security checks by Citizenship and Immigration Canada (CIC) prior to entering the country (Government of Saskatchewan, 2011). The majority of the categories require prospective immigrants to have a job offer from a Saskatchewan employer as the province wants to nominate people who have the skill and educational background for the proposed employment (Government of Saskatchewan, 2011). A medical examination is required, and must be passed prior to entry, in order to ensure immigrants are not a danger to public health and/or safety and do not have certain health issues that would pose an excessive demand on health or social services (Citizenship and Immigration Canada [CIC], 2009). Saskatchewan received 7,617 permanent residents in 2010, of which 3,178 settled in Saskatoon (CIC, 2011). There were 491 children aged 5-9 years and 484 children aged 10-14 years who immigrated to Saskatchewan in 2008 (Government of Saskatchewan, 2008).

2.2 *Immigration and Health*

The World Health Organization (WHO) directs and coordinates health within the United Nations (World Health Organization [WHO], 2009a). The WHO defined health in 1948 as “a complete state of physical, mental and social well-being, and not merely the absence of disease or infirmity.” Although the WHO has defined health, it can be interpreted differently according to an individual or a group. This organization deals with health at the global level and has yet to include emotional or spiritual aspects in their definition, which are often incorporated in various cultural views of health (Kittler & Sucher, 2008). The biomedical view of health, which is most

common in Canada and the United States, believes there are three causes of disease including an immediate cause such as infection, an underlying cause such as high cholesterol, and an ultimate cause such as heredity (Kittler & Sucher, 2008). Many cultures believe in four theories that cause disease including the patient, the natural world, the social world and supernatural causes (Kittler & Sucher, 2008). For example, three of the most common beliefs of Hispanics are in natural and supernatural forces, an imbalance of heat and cold, and emotions as a cause of disease (Krajewski-Jaime, 2001). Health among Hispanics includes a strong body, the ability to maintain a high level of physical activity, and the absence of pain (Krajewski-Jaime, 2001). Eastern medicine finds importance in energy systems and the need for a constant flow of energy throughout the body and mind. Any cease in this balance of energy indicates a disease state (Saylor, 2004). Thai women indicate that their health is dependent on family and friends and signifies an ability to perform daily, social, and community duties and activities, and an ability to adapt to new situations (Lundberg, 1999). Thai women also include in their definition of health an absence of illness and disease as well as presence of quality exercise and nutrition, with an emphasis placed on consumption of vegetables and milk (Lundberg, 1999).

Traditional, complementary, or alternative medicines include knowledge, skills, practices, beliefs, and experiences of native cultures (WHO, 2000). Immigrants with a higher socio-economic status tend to be more knowledgeable about health and follow Western medicine instead of their traditional medicine (Rothstein & Rajapaksha, 2003). They are also more likely to maintain a healthy body weight, go for preventive health exams, and exercise more frequently (Rothstein & Rajapaksha, 2003). Those who are not satisfied with Western healthcare, whether due to high costs, long wait times, or perceived discrimination, tend to use traditional or complementary medicine more than those who are satisfied with their treatment (G. Lee, Charn, Chew & Ng, 2004; Ku, 2007). People are also more likely to use traditional or complementary medicine if they have strong beliefs or if they have family members who use it (G. Lee et al., 2004).

Health is an increasingly talked about subject among Americans, however, their diets contain processed foods that are high in fat and sugar, which negatively influences their health (M. Lee & Huang, 2001). “In the United States, dietary intake and nutritional factors have been associated with 6 of the 10 leading causes of death: hypertension, coronary heart disease, cancer, cardiovascular disease, chronic liver disease, and type 2 diabetes mellitus” (M. Lee & Huang,

2001). These same issues are found among Canadians. For example, “two out of every three adults in Canada are overweight or obese” (Health Canada, 2006). Over 40% of Canadian adults have high cholesterol and a greater prevalence of obesity than those with normal cholesterol levels (Statistics Canada, 2010b). In 2004, 90% of Canadians who had been diagnosed with hypertension also had other cardiovascular disease (CVD) risk factors (Campbell, 2004). Diabetes affects 11% of obese Canadian men, however, only 2% of men with a normal body mass index (BMI) (Tjepkema, 2005). Studies suggest immigrants who leave behind their traditional foods and eat more Western foods are at a higher risk of increased body weight, coronary heart disease and certain kinds of cancers (M. Lee & Huang, 2001). The ‘healthy immigrant effect’ occurs when immigrants arrive in a new country and their health is better than that of the native population; however, as their length of stay increases in the country, their health begins to decline (Gushulak, 2007; Kopec, Williams, To, & Austin, 2001; Newbold, 2005). There are three main hypotheses associated with the ‘healthy immigrant effect’ (Gushulak, 2007; McDonald & Kennedy, 2004). The first hypothesis involves selective immigration, the second is due to improved access to healthcare over time, and the third revolves around acculturation (Antecol & Bedard, 2006; McDonald & Kennedy, 2004). In order to understand the ‘healthy immigrant effect,’ these hypotheses need to be investigated further.

2.2.1 Selective Immigration

Immigrants are believed to be healthier upon arrival due to self-perceived health and self-selection, a term used to describe those who are healthy and economically successful in their native countries and therefore more likely to immigrate for greater opportunities (Antecol & Bedard, 2006; McDonald & Kennedy, 2004). Immigrants must also pass a screening process in order to be granted entry into a new country, which includes a medical examination (Antecol & Bedard, 2006). The screening process was implemented to filter out those who have severe medical conditions that could pose a danger to public health or safety and would place stress on the healthcare system with the cost of their care projected to be greater than that of the average Canadian, which is \$2,500 per year (Antecol & Bedard, 2006; Laroche, 2007). Using data from four cycles of the National Population Health Survey (NPHS), longitudinal surveys performed by Statistics Canada, Newbold (2005) found that recent immigrants rank their health higher than

the Canadian-born and are less likely to develop chronic conditions or disabilities. Some believe this is most likely due to health screenings prior to immigrating, allowing only healthy immigrants to enter the country (Newbold, 2005). However, in another study that combined multiple cross-sections of data from the NPHS and the CCHS, McDonald and Kennedy (2004) found that few immigrants are actually denied entry to Canada due to health issues. McDonald & Kennedy's (2004) conclusion appears to have been derived from self selection since only 1.7% of potential immigrants were deemed inadmissible to Canada in 1996 (Laroche, 2000; Antecol & Bedard, 2006).

Newbold (2005) found that a rapid decline in health in less than ten years is most likely due to changes in perceived health rather than actual health status. This hypothesis of the 'healthy immigrant effect' is supported by the fact that ethnic groups memorize information, think, and report cognitive symptoms differently, therefore making them more likely to interpret health differently (Kopeck et al., 2001; McDonald & Kennedy, 2004). The 1994/1995 NPHS found immigrants reported worse health than the native-born; immigrants from Asia, Africa, and South America are less likely to report excellent/very good health when compared to those from Europe, United States, Australia, and Mexico combined (Ali, McDermott, & Gravel, 2004). For many immigrants and refugees, their definition of health changes over the years due to acculturation, as they begin to compare themselves to the native-born, which affects their perceived health (Kopeck et al., 2001; McDonald & Kennedy, 2004; Newbold, 2005). A cross-sectional study analysed longitudinal data and concluded poor self-reported health to be significantly associated with poor language proficiency in women (Pottie, Ng, Spitzer, Mohammed, & Glazier, 2008).

Although it is true that self-selection exists, it is likely only one contributing factor to the 'healthy immigrant effect' and may not apply to all migrants. Self-selection does not take into account the decline in health post-migration that occurs in refugees. We must, therefore, turn to other hypotheses of the 'healthy immigrant effect' for further understanding of this theory.

2.2.2 Healthcare

Poor health has been found to manifest over a period of five years post-migration (Gray, Cossman, Dodson, & Byrd, 2005; Kaushal, 2009). Based on Laroche (2000), which used two

cycles of the General Social Survey, new immigrants to Canada do not necessarily have better health than Canadians. Self-perceived health of immigrants is higher upon entry than that of the native population, even though they use the healthcare system less (Gushulak, 2007). Barriers to the healthcare system are most likely to occur for immigrants upon entry to the host country and include a poor socioeconomic status, loss of social networks, difficulty speaking the host country's language, and poor working conditions associated with 'deskilling,' which occurs when the host country does not acknowledge immigrants' education from their native country (Newbold, 2005). Immigrants to Canada are required to go through a three month waiting period prior to receiving access to the free healthcare system, which may contribute to their lower usage of the healthcare system upon entry; however, there are healthcare programs specifically for refugees (Newbold, 2009). Immigrants' use of healthcare increases with their length of stay, which is believed to result in increases in recognizing, reporting, diagnosing, and treating health issues (Newbold, 2009).

Immigrants have less access to healthcare and worse coverage than native-born Canadians and Americans, which is limited more for women due to familial and cultural responsibilities (Derose, Bahney, Lurie, & Escarce, 2009; Newbold, 2009). Even when immigrants are insured, they are less likely than native-born Canadians to access medical care, primarily due to the language barrier and perceived discrimination (Ku, 2007). "Perceived discrimination has an impact on mental and physical health through direct effects on individual psychology and physiology as well as through links to other [social determinants of health]" (Simich & Jackson, 2010). Canadian visible minorities are most likely to experience perceived discrimination, particularly Blacks at 32%, South Asians at 21% and Chinese at 18% (Simich & Jackson, 2010). Data from the NPHS indicates hospital use did not increase from 1994/1995 to 2000/2001 for Canadian immigrants even though self-assessed health decreased (Newbold, 2009). This implies that immigrants are either receiving inferior healthcare or the health issues causing poor health are not serious enough for a hospital visit or treatment is provided at home through traditional medicine (Newbold, 2009). In Ontario, outpatient physician services were used more by African and female Middle Eastern immigrants compared to Canadian-born (McDermott et al., 2010). South Asian immigrants also used outpatient physician services more than the Canadian-born in Ontario and British Columbia (McDermott et al., 2010). Healthcare expenditures for immigrants in the United States were 55% lower for adults and 74% lower for

children when compared to the American-born (Derose et al., 2009). However, emergency department expenditures alone were more than three times higher for immigrant children (Derose et al., 2009). This could be due to the use of traditional medicine for less serious conditions.

Foreign-born children have more barriers to healthcare than the native-born (Weathers, Novak, Sastry, & Norton, 2007). Insurance has been found to coincide with healthcare usage and from 1995-2005, in the United States, the percent of uninsured native-born children decreased from 19% to 15% (Ku, 2007). However, the number of uninsured immigrant children increased from 44% to 48% during that same time period (Ku, 2007). Ku (2007) also concluded that 26% of low-income immigrant children have a regular source of healthcare compared to only 6% of native-born Americans. Among insured children, only 26% of immigrants had employer-based health coverage, which was much less than 44% of the American-born (Derose et al., 2009). Children with foreign-born parents had lower perceived health and were less likely to have constant healthcare (Weathers et al., 2007). Immigrant children are at a disadvantage when it comes to medical care; they use the emergency room less yet have higher emergency medical expenditures, most likely due to more severe illnesses arising from less primary care (Ku, 2007).

Newcomers have less access to healthcare services than the Canadian-born due to perceived discrimination, language barriers, less insurance coverage, and greater use of traditional medicine. However, there are likely other factors than poor access to healthcare that are responsible for the health decline observed among newcomers post-migration. Like the hypothesis of self-selection, poor access to healthcare does not apply to refugees who are given access to healthcare immediately upon entry into Canada. We can, therefore, conclude that there are other contributing factors associated with the ‘healthy immigrant effect.’

2.2.3 Acculturation

The first two hypotheses of the ‘healthy immigrant effect’ portray two separate ideas regarding immigrants’ health status, but are not necessarily applicable to refugees. Neither hypothesis can provide any concrete evidence to indicate it is the sole contributing factor to the observed health decline. It is therefore logical to conclude that there are more factors associated with the ‘healthy immigrant effect,’ which may be explained by the third hypothesis. Kittler and

Sucher (2008) define acculturation as the adaptation of an ethnicity to a new culture's norms. There are different theories of acculturation comprised of various stages. Typically, the last stage is described by the term 'assimilation,' which occurs when someone from a different ethnicity completely adopts the norms of their new culture and leaves their own behind (Satia-Abouta, Patterson, Neuhouser, & Elder, 2002; Kittler & Sucher, 2008). Those who migrate at a younger age are more likely to assimilate to their new culture than those who migrate at an older age (Kaushal, 2009). In Canada, immigrants with a European background can identify with their new country after a period of ten years; however, immigrants with a non-European background may experience more challenges due to an inability to speak the language as well as various other cultural differences (Barimah & van Teijlingen, 2008). Ideally, there should be a balance between keeping certain aspects of the old culture while still being able to incorporate the new.

Acculturation to the majority culture increases the likelihood of becoming obese, a condition that can lead to increased blood cholesterol levels and increased risk of developing hypertension, heart disease, type 2 diabetes and some cancers; most conditions resulting from poor dietary choices (Kittler & Sucher, 2008). Dietary acculturation occurs when an individual or group of a minority population adopts the eating patterns and food choices of the native-born population (Satia-Abouta et al., 2002). Dietary acculturation is of importance among immigrants to developed countries as the American diet is high in fat and sugar which has been found to negatively affect immigrants' health as their duration of residence increases in the host country (Satia-Abouta et al., 2002). Reasons for dietary acculturation include unavailable or expensive traditional food items, a lack of nutrition education, and convenience in preparation of Western foods, resulting in an increase in consumption of pre-packaged items or fast food dinners (Kittler & Sucher, 2008; Satia-Abouta et al., 2002). A low number of supermarkets ('supermarket abandonment') along with a high number of fast food restaurants in African-American and low income neighbourhoods compared to Caucasian neighbourhoods, further contributes to these dietary health issues (Kittler & Sucher, 2008). Immigrants who are more acculturated have lower vegetable, fruit, and fibre intake, higher fat consumption, higher levels of sedentary activities, and therefore an increased risk of obesity (Flores & Brotanek, 2005; Singh, Kogan, & Yu, 2009). Since we are seeing an increase in chronic diseases due to dietary acculturation in adults, it is plausible that health will be more negatively affected in those who experience dietary acculturation as children.

Acculturation is the hypothesis of the “healthy immigrant effect” that affects both refugees and immigrants. It is important to pay attention to dietary choices as these have been found to play a major role in overall health status. Canada lacks information on health and nutritional status of immigrant and refugee children. However, we can turn to other developed countries such as the United States to gain insight into their health status as there are also significant levels of immigrants in the United States. For example, one in five children living in the United States is from an immigrant family (Babington & Patel, 2008). The health status of children of immigrant mothers who have been in the United States for less than ten years has been found to be worse than children whose mothers are born in the United States (Chilton et al., 2009). Mexican-American children’s health worsens with increased acculturation; they have the highest percentage of children in fair or poor health (Burgos, Schetzina, Dixon, & Mendoza, 2005). Health issues in children can arise due to poor dietary choices, which will lead to the development of overweight and obesity and eventually chronic diseases (Shields, 2005).

2.2.4 Interaction Paradigm

The interaction paradigm is another theory that tries to explain why the health of newcomers deteriorates upon arrival to a new country. This theory is proposed by Beiser (2003) as an alternative to the ‘healthy immigrant effect.’ The interaction paradigm attempts to encompass multiple factors instead of the three main hypotheses of the ‘healthy immigrant effect.’ The interaction paradigm emphasizes pre- and post-migration stressors such as reactivation of communicable diseases, genetic predisposition, country of origin, pre-migration trauma experienced by refugees, acculturation, poverty, unemployment, and perceived discrimination (Beiser, 2003). However, the interaction paradigm proposes that it is not only the individual factors that affect a migrant’s health but an interaction of multiple factors (Beiser, 2003).

Although the interaction paradigm is encompassing of all variables that arise over the course of the migration experience, it does not provide a starting point as to how to address these health issues. The focus on acculturation by the ‘healthy immigrant effect,’ particularly dietary acculturation, presents an area of health where we can implement change. The interaction

paradigm does, however, bring forth the idea that both pre- and post-migration factors contribute to the observed health decline, with increased length of stay, in newcomers to Canada.

2.3 *Lifestyle Factors*

There are many lifestyle factors associated with the health decline in immigrants and refugees post-migration. The two main factors include nutrition and physical activity, which are explored below in more detail. The section on “Nutrition” explores more closely what occurs during dietary acculturation. Often times, traditional food is too expensive or unavailable, which can directly affect the nutrition quality of foods selected. In addition, it is exposure to and consumption of unhealthy and less expensive Western foods that results in poor nutrition. Physical activity and sedentary activity are other factors that contribute to the observed health decline.

2.3.1 *Nutrition*

The type of food people consume plays a major role in their health status. This is directly related to the fact that culture influences food choices. Affordability of food can limit people from purchasing healthy foods (Kittler & Sucher, 2008). Food choices of newly arrived immigrants are influenced by cultural differences, often due to a limited availability of traditional foods and differences in schedule, such as having to work long hours, resulting in minimal time to prepare food. The likelihood that food habits will change is affected by country of origin, city of relocation, English comprehension, and income level (Gray et al., 2005). Parents typically prefer traditional foods whereas children seem to prefer Western foods (Gray, et al., 2005).

Vegetable and fruit intake is directly related to risk of obesity (Flores & Brotanek, 2005; Singh et al., 2009). Newcomers to Canada may not know how to cook/prepare Canadian fruits and vegetables if their traditional ones are unavailable. They may, therefore, omit this important group of foods from their diet. However, consumption of vegetables and fruit are important indicators of a healthy diet, along with whole grains and milk products. Eating Well with Canada’s Food Guide provides recommendations for age and sex groups as to how many servings per day of each food group people should consume (Health Canada, 2011a). Children

aged 4-8 years should consume five servings of vegetables and fruit, four grain products, two milk and alternatives, and one meat and alternatives (Health Canada, 2011a). Children aged 9-13 years should consume six servings of vegetables and fruit, six grain products, three to four milk and alternatives, and one to two meat and alternatives (Health Canada, 2011a). Other recommendations are to make half your grain products whole grains and eat at least one dark green and one orange vegetable each day (Health Canada, 2011a). In 2004, 71% of Canadian children aged 4-8 years, and 62% of girls and 68% of boys aged 9-13 years were not getting the recommended servings per day of vegetables and fruit (Garriguet, 2007). Canadian children were also doing poorly with milk consumption as 37% of children aged 4-9 years and 61% of boys and 83% of girls aged 10-16 years were not obtaining the recommended number of servings per day (Garriguet, 2007). More than 25% of children aged 4-8 years were not consuming enough whole grains (Garriguet, 2007). As well, 14-18% of girls aged 9-18 years were not getting the recommended amount of meat and alternatives (Garriguet, 2007).

The Healthy Eating Index (HEI) uses a point system on a scale of 1 to 100 to evaluate certain aspects of a person's diet to conclude if their diet is good (>80pts), needing improvement (50-80pts), or poor (<50pts). The HEI was originally developed by the United States Department of Agriculture (USDA) and adapted by Canada. The HEI-2005 is the USDA's most recent version of the HEI. The HEI-2005 evaluated the diets of children in three age groups: 2-5 years, 6-11 years, and 12-17 years (Fungwe, Guenther, Juan, Hiza, & Lino, 2009). The mean HEI-2005 score for American children aged 2-17 years was 55.9. Specifically in the 6-11 years age group, the mean HEI-2005 score was 54.7 (Fungwe et al., 2009). Overall, this means that the diets of American children also need improvement. Children in the 6-11 years age range met recommendations for grain consumption, however, did worst in the dark green and orange vegetables and whole grains components of the HEI-2005 (Fungwe et al., 2009). Sodium, saturated fat, and total vegetable intake components were all poor as well (Fungwe et al., 2009). Statistics Canada adopted the USDA HEI taking into account Eating Well with Canada's Food Guide. In 2004, the average score for Canadian children aged 4-8 years was 65.4, for boys aged 9-13 years the mean score was 59.7 and for girls in that same age range, the mean score was 60.0 (Garriguet, 2009). The scores of those aged 9-13 years were significantly different than those of children aged 4-8 years (Garriguet, 2009). For Canadians, in all age and sex groups, their diets were found to need improvement (Garriguet, 2009). The percentage of children aged 4-8 years

whose diets needed improvement was 96.5% (Garriguet, 2009). For those aged 9-13 years, 91.3% of boys and 92.1% of girls were also found to be in the category where their diets need improvement (Garriguet, 2009).

2.3.2 *Food Security*

Data from the CCHS (2007-2008) revealed that 7.7% of Canadians experienced some form of food insecurity, 2.7% of whom were categorized as severely food insecure, the lowest category of food security below both food secure and moderately food insecure (Health Canada, 2011b). Saskatchewan had the lowest prevalence of food insecurity among all of Canada's provinces with 6.3% of its population affected (Health Canada, 2011b). Of the 961,000 Canadian households affected by food insecurity, 228,500 had children (Health Canada, 2011b). Food insecurity was more prevalent in households with low income, younger children, higher numbers of children, and lone-parent households, especially those with single mothers and where the main source of income was social assistance and/or Workers' Compensation (Health Canada, 2011b). For example, in Canada, 32% of single mother households were food insecure; they also had lower incomes and a greater dependence on social assistance (Che & Chen, 2001).

Since 2004, Statistics Canada has collected information on the food security status of Canadians by means of the CCHS. The CCHS is the only comprehensive nationally representative data that provides information in regards to food security in immigrant and refugee children in Canada. The prevalence of food insecurity was similar among immigrants and native-born Canadians signifying a greater relationship between food insecurity with income and education (Health Canada, 2011b). There was a difference, however, in recent immigrant households (less than five years in Canada) of which 12.6% are food insecure when compared to food insecurity in non-recent immigrant and non-immigrant households at 7.8% and 7.5% respectively (Health Canada, 2011b).

Food security is directly related to income. A major concern regarding food security for the poor is the constant rise of food prices, which has become an increasing burden since most low-income people will spend anywhere from 50-80% of their incomes on food (IDC, 2008). One study reported 35% of low-income households and 14% of middle-income households experience food insecurity (Che & Chen, 2001). Data from the Survey of Labour and Income

Dynamics (SLID), a longitudinal Canadian study from 1993-1998 and 1996-2001, categorized immigrants into three groups: early (17 or more years in Canada), mid-term (7-16 years), and recent (1-6 years) (Palameta, 2004). Mid-term and recent immigrants were twice as likely as native-born Canadians to have had a low income for at least one year and recent immigrants were more than three times as likely as the Canadian-born to have a low income for at least three years (Palameta, 2004). Immigrant visible minorities have a higher likelihood of having been in a low wage job and having received lower pay than Canadian non-visible minorities (Simich & Jackson, 2010).

Higher education levels typically provide more opportunities, higher income, and consequently a more desirable food security status. However, for immigrants, higher education often does not translate into employment attainment due to de-skilling, which helps explain why immigrants experienced lower levels of food security compared to the Canadian-born. Recent data from the CCHS (2011) revealed that food security is even lower in households that did not have a post-secondary graduation level of education. Foreign-born Canadians make up 40% of Canadians with a Masters degree and 49% of Canadians with a Doctorate (Cymbal & Bujanowski, 2010). The SLID also reported that 48% of immigrants without a high school education had low incomes for at least one out of six years whereas only 18.2% of the Canadian-born experienced the same issue (Palameta, 2004). Recent immigrants, even those with post-secondary education, were more likely to be underemployed, low-income, and need housing compared to the Canadian-born (Simich & Jackson, 2010).

Food insecurity results in lower consumption of fruits, vegetables, milk, and fibre as well as inadequate intakes of other vital nutrients (Kirkpatrick & Tarasuk, 2008b). The lack of nutrients from poor intake of fruits and vegetables decreases immune system function and increases the likelihood of developing a chronic disease, particularly obesity in women (Che & Chen, 2001; Kirkpatrick & Tarasuk, 2008b). The term malnutrition comprises both under-nutrition and over-nutrition and develops due to inadequate or excess intake of protein, energy, and micronutrients. Malnutrition can also occur when the body is unable to absorb and use essential nutrients due to illnesses/diseases such as diarrhoea (WHO, 2001). Malnutrition causes deficiencies such as vitamin A, zinc, iron and iodine, which can affect physical development/growth, particularly in children, increase one's risk of diseases, and influence adults' ability to work and children's concentration levels/overall performance at school (IDC,

2008; WHO, 2001). Refugees, particularly children, are prone to infection which is only heightened by unsanitary living conditions and malnutrition (Food and Agricultural Organization [FAO], 1995). Families with lower incomes and less health education (e.g., newcomer refugees) are more likely to be malnourished (WHO, 2001).

People who are food insecure have a tendency to binge eat, consume high calorie foods and therefore develop higher BMIs (Che & Chen, 2001). Children in households where the highest level of education is high school are more likely to be overweight/obese when compared to those in households where someone has a post-secondary degree (Shields, 2005). Reports indicated that 21% of people in food insecure households had at least three chronic conditions and obesity occurred in 15% of these people (Che & Chen, 2001). Since the CCHS 2008 did not distinguish between refugees and immigrants, it is likely that food insecurity is underestimated in refugees and overestimated in immigrants.

2.3.2.1 Food Assistance

In 2006, the World Food Programme (WFP) fed 20 million children by providing nutritious food to schools; however, they are not the only program that implements feeding programs at schools (IDC, 2008). Gardens have been planted at schools as well as throughout communities in communal areas and private homes (FAO, 2006). Mother and child health programmes are another focus of the WFP as they deliver nutritious, fortified food that is vital for children's growth and development (IDC, 2008). Food Assistance Programs were introduced in Canada in the 1980s in the form of food banks where donated food is redistributed to those in need by means of volunteer labour (Tarasuk, 2001). Over the years, other programs were developed including community kitchens, targeted education programs, community gardens, food-buying clubs, farmers' markets, alternative food distribution networks, and community-supported agriculture (Tarasuk, 2001).

The Public Health Agency of Canada (PHAC) has early intervention programs for communities with a large immigrant base including the Community Action Program for Children and the Canada Prenatal Nutrition Program (Health Canada, 2010a). The Child Nutrient and Development Program, Food Banks, and Food Secure Saskatchewan are all food security initiatives offered by the Saskatchewan Ministry of Social Services (Saskatchewan Ministry of

Advance Education, Employment and Immigration, 2009). The Child Nutrient and Development Program is jointly funded by the government and communities to support approximately seventy community-based organizations including, but not limited to, collective kitchens, food box programs, and community gardens (Saskatchewan Ministry of Advanced Education, Employment and Immigration, 2009).

2.3.3 Physical Activity

Less than 50% of Canadian children and adolescents aged 5-17 years were active enough, defined as having an energy expenditure of at least 8kcal/kg of body weight per day, for optimal growth and development (Public Health Agency of Canada [PHAC], 2002). Boys were generally more active than girls with only 38% of girls being active enough, compared to 48% of boys (PHAC, 2002). Physical activity levels can also be assessed by looking to the sedentary activity levels of a person. Media influences the types of foods people consume as studies have shown people who watch more than the recommended two hours of television per day have increased consumption of high fat and high sugar foods (Manios et al., 2009). This recommendation has shifted slightly with the introduction of the term “screen time” which includes not only television, but video games and computer time as well (Shields, 2005). One study reported that Canadian children who had more than two hours of “screen time” per day were twice as likely to be overweight or obese when compared to children with one or less hours per day (Shields, 2005). Television viewing is associated with lower levels of physical activity, decreased vegetable and fruit consumption, and greater consumption of high-fat high-sugar snack foods, fast foods, and soft drinks (Manios et al., 2009). It also exposes children to commercials that promote fast foods and unhealthy dietary behaviour. Television companies in Sweden are prohibited from airing food promoting programs geared towards children under the age of twelve in an effort to prevent temptation of high fat and high sugar foods in children (Magnusson, Hulthen, & Kjellgren, 2005). Vietnamese mothers in Sweden also stated their children tend to watch an abundance of television if the mothers were at work and unable to ensure their children get enough physical activity (Babington & Patel, 2008).

2.4 *Chronic Conditions*

If the prevalence of chronic diseases in the world could be reduced by 2% each year over the course of the next ten years, 2.4 million lives would be rescued from premature death and eight billion dollars saved (Rubinstein, Alcocer, & Chagas, 2009). The ‘healthy immigrant effect’ indicates a need for preventive strategies in order to address health issues that are developing in immigrants and refugees post-migration, which include obesity, CVD, hypertension, diabetes, osteoporosis, and deficiencies in important nutrients such as vitamin D and calcium. Genetics has been found to be a factor in the development of chronic diseases in some ethnicities (Beiser, 2003; Gray et al., 2005). However, most chronic diseases develop due to poor nutrition and an overall unhealthy lifestyle. It is therefore vital to explore nutrition in immigrants and refugees, particularly children, and how it affects their health.

2.4.1 *Obesity*

The WHO (2006) defines overweight and obesity as “abnormal or excessive fat accumulation that may impair health.” There were approximately 1.6 billion overweight and 400 million obese adults in the world in 2005 (WHO, 2006). Obesity occurs due to physical, genetic, social, environmental, and behavioural characteristics (Fonseca, Matos, Guerra, & Pedro, 2009; Murray, 2009). BMI is a measurement of weight in kilograms divided by height in squared metres that is often used to assess a person’s health (Antecol & Bedard, 2006; Kaushal, 2009). In children, at risk of overweight is defined as having a BMI greater than one standard deviation above the median, approximately the 85th percentile, and obese as greater than two standard deviations above the median, which is approximately the 97th percentile (WHO, 2007). Thinness in children is defined as having a BMI less than two standard deviations below the median, which is approximately the third percentile and severe thinness is three standard deviations below the median (WHO, 2007). However, BMI values can be inaccurate since they do not take into consideration variation in fat distribution, different levels of adiposity in various individuals and do not differentiate lean tissue, body fat percentage, or bone tissue from body mass (Luke, 2009). Some studies suggest measurements of waist circumference and waist-height ratio are better predictors of CVD (Li, Ford, Mokdad, & Cook, 2006). Waist circumference measures

abdominal obesity, which is a better indicator of visceral fat than BMI (Li et al., 2006). Although a waist circumference cut-off value for abdominal obesity in children has not been agreed upon in the literature, the 90th percentile for age and sex has been suggested as the cut-off value by Li et al. (2006) who used data from the National Health and Nutrition Examination Survey (NHANES) III. Li et al. (2006) did find that “the increase in the mean [waist circumference] and [waist-height ratio] and the prevalence of abdominal obesity occurred consistently across different sex, racial/ethnicity, and age subgroups.” Percent total body fat can also be used to assess overweight and obesity. In the absence of dual energy x-ray absorptiometry (DXA)-derived values, a study performed in the United Kingdom created prediction equations using bio-impedance measurements that were validated against DXA measurements (McCarthy, Cole, Fry, Jebb, & Prentice, 2006). For boys in the United Kingdom study, the 50th centile remained flat, between 15-18% with a peak at age 11 years (McCarthy et al., 2006). Centiles for girls are similar to those for boys up to age 10 years, where the 50th percentile begins to rise slightly while the other centiles diverge from the 50th centile (McCarthy et al., 2006). This resulted in girls having 60% more body fat than boys at 18 years of age (McCarthy et al., 2006). The results of this study indicate the difference in fat distribution in different sexes at the onset of puberty (McCarthy et al., 2006).

Many studies have been conducted to evaluate differences in BMI values in various ethnicities due to genetics, diet, and activity levels. Asians, particularly Asian Indians have higher body fat when compared to other ethnicities (WHO, 2006). Different BMI cut-offs for this population have been suggested; however, the WHO found that the cut-offs do not vary enough (WHO, 2006). Significant differences in body fat distribution were found in black and white South African women, however, the relationship between their BMI and body fat was not found to be significantly different (Luke, 2009). Other studies have also produced conflicting evidence, most likely due to different measurement techniques for body composition (Luke, 2009). Therefore, there is not enough conclusive evidence to indicate that different BMI cut-offs should be used for different ethnicities, and the international values remain in effect (Luke, 2009; WHO, 2006). Dietitians of Canada, Canadian Paediatric Society, The College of Family Physicians of Canada, and Community Health Nurses of Canada (2010) recommend the WHO cut-off values be used across Canada. The major factors that affect obesity include age, education, diet, and exercise (Antecol & Bedard, 2006; Kaushal, 2009).

Healthy weight can be maintained through lifestyle changes by adopting healthy eating patterns and improving exercise habits. A high BMI, indicative of overweight/obesity, is of particular concern for immigrants as they already experience barriers to healthy food choices, which include a greater consumption of inexpensive high caloric food and beverage items and decreased access to healthcare services. Further, some ethnicities may not seek treatment for health concerns as they do not fit their definition of poor health (McDonald & Kennedy, 2004; Newbold, 2005). Obesity has been found to increase the most in the first five years after migration (Kaushal, 2009). Recent immigrants were 60% less likely and long-term immigrants only 20% less likely to suffer from overweight/obesity compared to the Canadian-born (Betancourt & Roberts, 2010). Latin Americans and those with a Caribbean origin are the ethnicities most likely to be obese whereas Asians are the least likely to be obese (Roshania, Venkat Narayan & Oza-Frank, 2008). When compared to the Canadian average rate of overweight/obesity at 26%, Southeast Asians and East Asians have the lowest prevalence of overweight/obesity of all ethnicities in Canada at 18% (Shields, 2005).

In a study by Antecol and Bedard (2006) using the National Health Interview Surveys to obtain cross-sectional data encompassing people aged 20-64 years of all ethnicities, women who enter the United States have BMIs that were two points lower than the native female population; however, within ten years their BMIs were the same as Americans. The same study reported men arrived with five points lower than the native male population and closed a third of the gap after fifteen years (Antecol & Bedard, 2006). Education is a determinant of obesity; people who have undergraduate degrees are less likely to be obese compared to those who have lower levels of education (Kaushal, 2009; Tjepkema, 2005). Since adult immigrants' BMIs converge to those of Americans, it can be assumed that the same will happen to children, but to a greater degree.

Over the past 25 years, the number of obese children living in Canada has increased nearly threefold (Health Canada, 2006). A European study found that 31% of children aged 11-12 years were overweight or obese (Magnusson et al., 2005). Of these children, 44% of the overweight and 23% of the obese perceived their health as average (Magnusson et al., 2005). Since these children viewed themselves as normal, they and their parents may not have been aware of the health issues they would soon begin to face if they continued with their current lifestyles (Magnusson et al., 2005). Of particular concern is the fact that obese children are more likely to become obese as adolescents and then as adults (Popkin & Udry, 1998).

Health issues seen in overweight and obese children can include hypertension, high triglyceride levels, hyperlipidemia, high cholesterol, noninsulin-dependent diabetes, increased growth during puberty followed by stunting, early onset of puberty in females including early menarche, asthma, pancreatitis, gall bladder disease, polycystic ovary syndrome, low self-esteem, depression and behaviour problems such as being victims or perpetrators of bullying (Babington & Patel, 2008). These health declines are only exacerbated by how easily children are influenced both by the media and their schoolmates.

Obesity coincides with lower fruit and vegetable consumption in both children and adults (Shields, 2005; Tjepkema, 2005). The CCHS found that the majority of children did not meet recommendations for servings of fruit and vegetables in 2004 (Garriguet, 2007). Children aged 5-11 years consumed approximately 2,000 calories per day (Garriguet, 2007). Total energy intake in Canadians did not significantly change from 1970-1972 to 2004, whereas that of Americans increased from 1971-1974 to 1995-2000 (Garriguet, 2007). The contribution of fat consumption of Canadian children and adolescents (<18 years) to total energy intake was within the Acceptable Macronutrient Distribution Ranges (AMDR) of 25-35% (Garriguet, 2007). Although Canadians' consumption of calories from fat decreased from 40% in 1970-1972 to 31% in 2004, concerns are still high as this value is an average and many people are still consuming well above the AMDR putting them at a greater risk of overweight/obesity and early establishment of chronic diseases (Garriguet, 2007). Over-nutrition occurs when people cannot afford nutritious food and therefore consume less expensive foods that end up being high in calories and fat, which is responsible for the continuous inclines of overweight and obesity resulting in chronic disease. It is crucial that children obtain proper nutrition in the early years of life otherwise they will face irreparable damage to their development (IDC, 2008). Although the CCHS 2.2 collected self-reported nutrition data in the general population including immigrants, to our knowledge no published data exists on patterns of food and nutrient intake in immigrant and refugee children in relation to overweight and obesity.

2.4.2 Hypertension

High levels of sodium in a person's diet are hypothesized to increase the likelihood of developing hypertension (Smith-Spangler, Juusola, Enns, Owens, & Garber, 2010).

Hypertension is thought to develop in childhood as children with higher blood pressures are more likely to develop hypertension later in life (Hunt, 1983; Whelton et al., 2002). Multiple studies have found that the average daily sodium intake in children exceeds the adequate intake (AI), which ranges from 1000-1500 mg per day for children depending on their age (Dholpuria et al., 2007; Falkner & Michel, 1997). Sodium sensitivity occurs when the amount of sodium consumed by a person is observed with a congruent increase or decrease in blood pressure (Falkner & Michel, 1997). Sodium sensitivity increases with age, however, it has varied greatly in individuals, most likely due to genetics (Falkner & Michel, 1997; Weidman, 1986).

In a study of chronic diseases in immigrants to Canada, recent immigrants (<5 years in Canada) were 30% less likely to have high blood pressure than the Canadian-born (Betancourt & Roberts, 2010). A study by Falkner & Michel (1997) found sodium sensitivity to be greater in African-Americans with a resultant increase in blood pressure when compared to Caucasians. The majority of studies have looked at adults and very few have examined the effects of sodium intake on hypertension in children.

Cut-offs for normal and abnormal levels of hypertension have not been identified in children, therefore, researchers have begun to use blood pressure above the 90th percentile as a point when intervention may be necessary (Feber & Ahmed, 2010). Hypertension is diagnosed when blood pressure levels are at or above the 95th percentile on more than three occasions (National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents [NHBPEP], 2004). Review articles have compared different studies and deemed the evidence inconclusive to determine if sodium intake affects hypertension in children even though some studies did find small decreases in blood pressure (Falkner, 1997; Watt & Foy, 1982; Weidman, 1986).

High levels of salt are found in many foods, however, extreme levels are found in processed food/fast food. Over-consumption of such foods can put children at greater risk of developing hypertension later in life. In 2006, He & MacGregor performed a meta-analysis on ten controlled trials in children and adolescents aged 8-16 years who had salt reduction for two or more weeks. When the median salt intake decreased by 42%, systolic blood pressure (SBP) and diastolic blood pressure (DBP) decreased significantly by -1.17 mm Hg and -1.29 mmHg, respectively (He & MacGregor, 2006). The results of this meta-analysis indicate that even modest decreases of sodium intake provoke an immediate and significant reduction in blood

pressure (He & MacGregor, 2006). The authors concluded that hypertension could be prevented if these lower sodium intakes are maintained with age (He & MacGregor, 2006). The prevalence of abnormal blood pressure in Canadian children was 7.4% in 2004 (Feber & Ahmed, 2010). To our knowledge, there are no studies that examine the effect of sodium intake on hypertension in children of different ethnicities. However, hypertension increases with length of stay in Canada in South Asian women (Hyman & Jackson, 2010).

2.4.3 *Diabetes*

Diabetes mellitus is a disease that exists in two forms. Type 1 diabetes mellitus occurs when the pancreas does not produce enough insulin, however, this is also seen in severe cases of type 2 diabetes mellitus (Canadian Diabetes Association, 2010; WHO, 2009b). Type 2 diabetes mellitus typically occurs when a person's body cannot effectively use insulin, which often coincides with being overweight or obese (WHO, 2009b). Of the more than 180 million people in the world who have diabetes, there were between 1.1-2.9 million deaths in 2005 (numbers vary as heart disease and kidney failure, which are resultant of diabetes, are reported as cause of death in some cases) (WHO, 2009b). Type 1 and type 2 diabetes cause high blood glucose levels, which is termed hyperglycaemia (WHO, 2009b). In Canada, 11% of obese men reported having diabetes whereas only 2.1% of men with normal BMIs reported having the disease; numbers are similar in women (Tjepkema, 2005). Risk factors for diabetes are primarily environmental and include a poor diet, decreased physical activity due to a sedentary lifestyle, and smoking, as well as genetic factors and ethnic predispositions (Misra & Ganda, 2007; Tomlin, Dovey, & Tilyard, 2008).

Diabetes is most common among African-Americans, particularly females, when compared to other ethnicities (CDC, 2009). A United States cross-sectional study found that as acculturation increased in non-Mexican Hispanics and Asians, so did the prevalence of diabetes (Kandula et al., 2008). South Asians are the fastest growing immigrant population in Canada (Sohal, 2008). They also develop diabetes up to ten years earlier and at a lower BMI than Caucasians in Canada, the United States, and the United Kingdom (Sohal, 2008). The prevalence of diabetes in South Asians continues to increase, possibly due to genetic predisposition, insulin resistance, higher levels of visceral/abdominal adipose tissue, and diets

high in fat and sugar (Misra & Ganda, 2007; Sohal, 2008). South Asians tend to receive inadequate treatment as they are faced with language barriers, low rates of literacy, lack of knowledge about diabetes, denial, and poor compliance with necessary lifestyle changes (Sohal, 2008). Another study in Canada found recent immigrants from South Asia, Latin-America, the Caribbean, and Sub-Saharan Africa were two to three times more likely to develop type 2 diabetes mellitus and develop it at a younger age compared to recent immigrants from Europe and North America (Hyman & Jackson, 2010). Although both type 1 and type 2 diabetes mellitus are increasing among children worldwide, there has not been much research in Canadian children, particularly in immigrants and refugees.

2.4.4 Cardiovascular Disease

CVD “is caused by disorders of the heart and blood vessels, and includes coronary heart disease (heart attacks), cerebrovascular disease (stroke), raised blood pressure (hypertension), peripheral artery disease, rheumatic heart disease, congenital heart disease and heart failure” (WHO, 2009a). CVDs are responsible for 17.7 million deaths globally per year (Rubinstein et al., 2009). Risk factors for CVD include obesity, hyperlipidemia, and hypertension, all of which are associated with acculturation (Edelman, Christian, & Mosca, 2009). According to Statistics Canada (2010b), more than 40% of Canadian adults aged 20-79 years have unhealthy levels of total cholesterol. The body has four types of blood lipids, which are triglycerides, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and very low-density lipoprotein cholesterol (Statistics Canada, 2010b). When transporting cholesterol, HDL-C prevents narrowing of arterial walls whereas LDL-C leaves cholesterol behind (Statistics Canada, 2010b).

Over 80% of CVD affects people living in developed countries (Kumar et al., 2009). Iranian immigrants in Sweden had higher rates of hypertension and smoking than those in Iran (Koochek et al., 2008). Immigrants are hesitant to be screened for CVD as they are fearful of finding they have a disease (Edelman et al., 2009). Approximately 30% of Canadian children aged 6-11 years had unhealthy levels of total cholesterol (Statistics Canada, 2010b). To my knowledge, there was not a study that evaluated total cholesterol levels in immigrant and refugee children in Canada.

2.4.5 Bone Health

The age at which peak bone mass acquisition is achieved is not certain, however, it generally occurs in females at 16-18 years of age and in males at 18-20 years of age (Osteoporosis Canada, 2009b; Caradonna & Rigante, 2009). Over 90% of total bone is acquired by late adolescence and by age 40, bone mass begins to deteriorate (Caradonna & Rigante, 2009; Nichols, Sanborn, Eassery, Clark & Letendre, 2008). Nutrition and weight-bearing physical activity are two important factors influencing bone mineral mass accumulation during childhood and adolescence as well as bone maintenance in adulthood (Osteoporosis Canada, 2009b; Nichols et al., 2008; Jonnalagadda & Diwan, 2002). Further, peak bone mass achieved early in life is a major determinant of osteoporosis and its consequences later in life (Osteoporosis Canada, 2009b). Various studies evaluated the relationship between diet, physical activity and bone health in different countries. However, to my knowledge, studies have not been conducted in 7-11 year old immigrant and refugee children in Canada.

Osteoporosis is a disease that affects bone due to a decrease in bone density and deterioration of bone tissue resulting in brittle bones (Carlsson & Johnson, 2004). There are no signs or symptoms of osteoporosis until fractures occur, particularly those of the hip, wrist, and spine (Osteoporosis Canada, 2009a; Carlsson & Johnson, 2004). Fractures can limit mobility and decrease one's independence, therefore, preventing one's ability to perform daily activities and impeding quality of life (Carlsson & Johnson, 2004). Osteoporosis is present in one in four Canadian women and one in eight Canadian men above the age of fifty years, affecting up to two million people (Osteoporosis Canada, 2009a; Carlsson & Johnson, 2004). Kreipe, in 1992, stated that "the prevention of osteoporosis, often deemed a geriatric disorder, may now be considered the legitimate domain of paediatricians." Studies have found that 75% of bone mass is influenced by genetics including gender, ethnicity, and hormonal status while 25% is influenced by environmental factors including nutrition, lifestyle behaviours, exercise habits, sunlight exposure, and eventual drug administration (Caradonna & Rigante, 2009).

Bone mineral content (BMC) and bone mineral density (BMD), as measured by DXA, are the most common measures used to examine bone. BMC is also referred to as bone mass and provides quantitative information while BMD is not actually a density but BMC divided by area and provides qualitative information (Faulkner et al., 1996; Molgaard, Thomsen, Prentice, Cole,

& Michaelsen, 1997). BMD is used to predict osteoporosis before fractures occur (Walker et al., 2007). A DXA machine is considered the ‘gold standard’ for defining osteoporosis (Fewtrell, 2003). The DXA uses two x-rays with different energies and a low radiation dose to determine the amount of mineral in any region (Faulkner et al., 1996; Fewtrell, 2003). The DXA also measures the depth and components of fat and lean mass (Fewtrell, 2003). The length and the width of the bone is also scanned by the DXA, however, it cannot measure the depth needed for BMD (Molgaard et al., 1997). BMD would therefore underestimate bone density in small subjects and overestimate bone density in large subjects (Fewtrell, 2003).

BMD cannot adjust for size differences in growing children and is not a useful indicator in this population, therefore, BMC is used (Fewtrell, 2003). Most studies using DXA in children have focused on the femoral neck, lumbar spine, and total body therefore providing normative data for these regions (Faulkner et al., 1996). Although not many studies have examined BMC in children aged 7-11 years, both Faulkner et al. (1996) and Molgaard et al. (1997) found similar results when measuring TBBMC. Faulkner et al. (1996) found mean TBBMC in girls aged 8-11 years to be 787-1151 grams while Molgaard et al. (1997) results were 777-1203 grams, which was also similar to the findings for boys at 809-1176 grams and 794-1186 grams, respectively. Overall, TBBMC in males and females aged 7-11 years is similar until age 17 years when TBBMC in males is higher, most likely due to males experiencing puberty later, and could be a factor affecting a greater likelihood in females to develop osteoporosis later in life (Faulkner et al., 1996). International paediatric reference standards for BMC were developed by Baxter-Jones et al. (2009); therefore I will compare my data with these standards.

Certain ethnicities have been found to be at greater risk for osteoporosis, particularly Caucasians, most likely due to low vitamin D, calcium, and protein levels as well as lifestyle and socio-economic conditions (Gong et al., 2006; Walker et al., 2007). One study found the rate of hip fracture in rural China to be the lowest in the world, whereas the rate of hip fracture in Hong Kong was continuing to rise (Walker et al., 2007). The Japanese government provides milk free of charge, which seems to be beneficial as Japanese women have higher BMD at the lumbar spine and hip than Chinese women (Gong et al., 2006). Caucasians have lower adjusted femoral neck BMD than African-Americans and Asians in the United States, which could be responsible for a greater likelihood of fractures among Caucasians (Gong et al., 2006). BMD of the lumbar spine and femoral neck was greater in African-American women than in Somali female

immigrants to the United States, most likely due to exposure to famine and war, pre-migration (Gong et al., 2006).

2.4.5.1 Nutrient Deficiencies

Vitamin D promotes bone, brain, lung and immune system development in a foetus (Litonjua & Weiss, 2007). It is a nutrient, available through consumption of such food products as oily fish, cod liver oil, and egg yolk; however, these are not commonly consumed. Even though vitamin D can be obtained from foods, the majority of vitamin D requirements, 80-90%, must be synthesized from the sun (Hintzpeter, Scheidt-Nave, Muller, Schenk & Mensink, 2008). Since vitamin D is limited in food, health concerns have arisen compelling some governments, particularly in areas of high latitude, to add the nutrient to foods; fortified products in some countries include milk, yogurt, and orange juice (Litonjua & Weiss, 2007). Fortifications specific to Canada include milk, which must contain (40 IU/100 mL) and margarine, which must provide (53 IU/10 g) (Poliquin, Joseph & Gray-Donald, 2009).

Vitamin D is hydroxylated in the body to eventually produce the biologically active form 1,25(OH)₂D (Mithal et al., 2009). Serum 25(OH)D is the main biomarker for evaluating vitamin D status; sufficient levels for bone health are greater than 50 nmol/L (Institute of Medicine [IOM], 2010). A deficiency in vitamin D is considered to be less than 30 nmol/L of 25(OH)D, referred to as hypovitaminosis D, which involves deterioration of cortical bone (Hintzpeter et al., 2008; IOM, 2010; Mithal et al., 2009). The calcitropic functions of vitamin D are to maintain extracellular calcium levels in the body and control calcium and phosphate absorption, which are associated with osteoporosis (Mithal et al., 2009; Whiting & Calvo, 2005). There are also non-calcitropic functions, primarily immune defence, which is associated with cancer, multiple sclerosis, and both type 1 and type 2 diabetes (Whiting & Calvo, 2005). Calcium deficiencies are often found among those who are also vitamin D deficient (Carlsson & Johnson, 2004; Nellen, Smulders, Frissen, Slaats & Silberusch, 1996). Hyperparathyroidism has been noticed in patients whose diets are high in unrefined cereals, which are high in phytates and impede calcium absorption (Pettifor, 2004).

The Institute of Medicine (IOM) (2010) set the current estimated average requirement (EAR) for vitamin D at 400 IU and the RDA at 600 IU for children and adolescents aged 1-18

years. The tolerable upper intake (UL) for children aged 4-8 years is 3,000 IU and 4,000 IU for children and adolescents aged 9-18 years (IOM, 2010). This EAR was set only as a protective measure for bone health and does not take non-calcitropic effects into consideration (IOM, 2010). The Canadian Cancer Society (2010) has recommended vitamin D intakes of 1000 IU per day for adult Canadians in the fall and winter months and year round for those at higher risk of deficiency. Vitamin D levels of 700-800 IU/day have been found to prevent fracture risk and the safe UL for vitamin D has been tested at 10,000 IU per day in adults (Vieth et al., 2007). The Canadian Pediatric Society (2007) recommends up to 800 IU per day of vitamin D in the winter months for children who live in northern countries. Immigrants to developed countries such as Canada are at a greater risk for vitamin D and calcium deficiencies.

Hypovitaminosis D is often found in immigrant women from minimal sun exposure due to cultural beliefs including full body veils for some women, a higher prevalence of melanin in the skin as darker skin pigments decrease the dermal synthesis of vitamin D, and higher parity (number of births) (Nellen et al., 1996). Other risk factors for vitamin D deficiency include sunscreen use, living in areas of high latitude (above 37 degrees latitude in the winter months), insufficient diets due to the unavailability of traditional foods, and genetics due to possible variation in transport protein expression (Grant & Holick, 2005; Hintzpeter et al., 2008; Mithal et al., 2009; van der Meer et al., 2006). Mithal et al. (2009) looked at vitamin D status in various regions around the world. When compared to Caucasian, Asian and African women in Canada, African-Americans and Mexican-Americans in the United States and Middle Eastern and Asian elderly immigrants in Australia all had lower vitamin D levels (Mithal et al., 2009). In a Canadian study of 107 adults aged 18-30 years, vitamin D levels less than 40 nmol/L were found in 22% of Europeans, 78% of East Asians, and 77% of South Asians (Gozdzik et al., 2008).

Bone deterioration due to vitamin D and/or calcium deficiencies (rickets) occur in children, primarily those aged 3-18 months (Pettifor, 2004). A vitamin D deficiency of <25-27.5 nmol/L is said to be representative of rickets (Roth, 2007; Ward, Gaboury, Ladhani, & Zlotkin, 2007; Whiting & Calvo, 2005). From 2002-2004, 150 cases of rickets were reported in Canadian children under the age of 18 years, a number which could be higher since only paediatricians were surveyed for the study and not family physicians (Ward et al., 2007). Darker skinned individuals represented 89% of children with rickets while 24% were immigrants (Ward et al., 2007). Vitamin D concentrations decreased in children as age increased, possibly due to less

milk consumption and greater consumption of high sugar beverages, decreased activity levels, and less exposure to the sun (Roth, 2007). Children who live in Canada at greater than 55 degrees latitude are more likely to be vitamin D deficient since the highest incidence of vitamin D deficiency is found in children from the Yukon, Northwest Territories, and Nunavut (Ward et al., 2007). Saskatoon is situated at latitude 52 degrees, which places its increasing number of immigrants at greater risk for vitamin D deficiency, which is also heightened by the majority having darker skin pigmentation (Tourism Saskatoon, 2010). Information specific to vitamin D status of immigrant and refugee children was not found in the literature.

Health issues are numerous in immigrants, especially in the first few years post-migration. Chronic conditions such as obesity and CVDs are on the rise due, primarily, to acculturation. Nutrient deficiencies are also prevalent in ethnic populations due to genetic and cultural differences influenced by age at migration, level of education, income, and food choices. It is of particular concern when these health issues are found in children, primarily due to nutrient deficiencies, which can severely impede development. Refugees are given homes in poor neighbourhoods since they migrate with little or no money. It is in these impoverished neighbourhoods where the risk of food insecurity is the highest (Nickel, Muhajarine, KidsFirst Program Managers, & KidsFirst Research Team, 2008). Although there are food assistance programs and health services, sometimes newcomers are not eligible to profit from them (Chilton et al., 2009). Awareness of food insecurity needs to be heightened as it is a very real and serious issue even in developed countries where, even though there is an abundance of food, it is by no means evenly distributed. Interventions are required to ensure health among immigrants and refugees, who may be unaware of prevention and treatment methods, particularly in regards to children who are more at risk. The literature provides important information on Canadians and immigrants and refugees, however, there is very little information on immigrant and refugee children in Canada, especially newcomers indicating a need for research in this area.

3. METHODOLOGY

3.1 *Design*

For this pilot study, in a cross-sectional design, health and nutrition measures were collected from 72 immigrant (n=33) and refugee (n=39) children aged 7-11 years who had been living in Saskatoon, Saskatchewan, Canada for no more than five years. This age range is an important time for bone acquisition and for establishing healthy dietary habits. Exclusion criteria included children who had been in Saskatoon more than five years and Canadian-born children.

Various strategies were used to recruit participants from the target population. Through close communication with Saskatoon Open Door Society I was able to recruit the majority of refugee participants for this study. Other organizations such as Saskatchewan Intercultural Association and City of Saskatoon assisted with recruitment. I also communicated with both the Public School Board and the Greater Saskatoon Catholic School Board for their help recruiting participants. Consequently, I sent advertisements to all elementary schools and immigrant/refugee-serving agencies in Saskatoon.

A sample size calculation was performed based on the number of predictors (7-10) for the three main outcome variables, serum vitamin D, food security, and TBBMC, with an anticipated moderate effect size of 0.15, a power of 0.8, and alpha set at 0.05 (Soper, 2011). The resultant predicted sample size was calculated to range from 103-118 participants (Soper, 2011). However, only 72 participants were able to be recruited for this pilot study. Considering a moderated effect size of 0.15 with alpha set at 0.05, the power for this study ranged from 50-60% based on the three main outcome variables (Soper, 2011).

3.2 *Measurements*

Initial testing was done at the College of Kinesiology facilities located in the Williams Building on the University of Saskatchewan campus. The location for the second and third 24-hr recalls was chosen by the participants for their convenience, either at Saskatoon Open Door Society or in the Williams Building. The questionnaires were administered to both the mother and the child to ensure all required information was gathered as young children alone sometimes have difficulty remembering the necessary information. Questions encompassed demographics,

socio-economics, household and child food security, dietary intake, and the physical activity level of the child. Before any measurements were conducted, all research assistants were required to go through planned training sessions, which included orientation to physical tests and their procedures as well as the questionnaires. The research assistants practiced administering the tests or questionnaires with volunteers outside of the study. They then observed a trained research assistant administer the test or questionnaire and then administered it themselves with feedback from the trained research assistant until they were able to obtain the necessary information without the assistance of the other research assistant. After initial training, nutrition graduate and senior undergraduate students were assigned to administer the questionnaires.

3.2.1 Demographics and Socio-economic Status

To examine demographics and socio-economic status, the socio-demographic questionnaire from the CCHS 2008 was used after being adapted for relevance to this study (Appendix C). Information was collected and summarized in four categories using eighteen questions. Based on the data collected, immigrant and refugee children were categorized according to age, sex, region of origin, household income level, main source of income, and parent education value. Table 3.1 presents household income categories according to the number of people in the household and Table 3.2 presents education categories.

Table 3.1 Household income categories defined by total income and number of people residing in the home

Number of people in household	Lowest Income	Lower-Middle Income	Upper-Middle Income	Highest Income
1-2	<\$15,000	\$15,000- \$29,999	\$30,000- \$59,999	≥ \$60,000
3-4	<\$20,000	\$20,000- \$39,999	\$40,000- \$79,999	≥ \$80,000
5+	<\$30,000	\$30,000- \$59,999	\$60,000- \$79,999	≥ \$80,000

Reference: Statistics Canada. (2008b). *Master and share files derived variables documentation*.

Recent national information was valuable to this study as it provided a comparison for data that was obtained. Of particular importance was information specific to immigrants provided by the CCHS.

Table 3.2 Education categories

Value of Education Category	Description
1	Less than secondary school graduation
2	Secondary school graduation, no post-secondary education
3	Some post-secondary education
4	Post-secondary degree/diploma

Reference: Statistics Canada. (2008b). *Master and share files derived variables documentation*.

3.2.2 Food Security Status

Food security was evaluated using sixteen questions adapted from the CCHS 2008 questionnaire (Appendix E). This questionnaire was originally designed by the USDA and has been validated in many countries, including Canada (Health Canada, 2007). Questions were asked in reference to income and the affordability of food. There were questions specific to adults (10 questions) and children (8 questions), which ranged in severity from ‘worrying food would run out’ to ‘a child not eating for a whole day.’ All responses were coded and scored using the same process as the CCHS. Depending on the final values, household food security was then categorized according to Health Canada (2007) criteria on a scale of zero to ten, whereby participants were food secure if their score was zero to one, moderately food insecure if their score ranged from two to five, and severely food insecure if their score was between six and ten (Statistics Canada, 2010). The USDA used slightly different categorizations than Health Canada, although, still based on a scale of zero to ten. The USDA categories consisted of two food secure categories, which were high food security, if the score was zero, and marginal food security, if the score was one to two, and two food insecure categories, which were low food security, if scores were between three and five, and very low food security for scores that ranged from six to ten. In this study, I evaluated food insecurity at the household level. Further, in order to determine child food security, only answers for the child-focused questions were used.

3.2.3 *Health Status*

Anthropometric measurements included height, weight, and waist circumference. The child removed his/her shoes for height and weight measurements. To obtain a child's weight, an analog scale by Health o meter, Alsip, USA was used, which was calibrated prior to the child stepping on and the value was recorded in kilograms to the nearest gram. The child's height was measured using a Karrimetre stadiometer by Raven Equipment Limited, Dunmaw, England. The child stepped on the platform of the stadiometer with his/her back to the measuring tape and the researcher ensured the contact points (heels, buttocks, and shoulder blades) were all lightly contacting the ruler and the child's head was in the Frankfurt plane (auriculo-orbital plane). The value was then recorded in centimetres to the nearest millimetre. All measurements were taken a second time for consistency in an effort to eliminate human error.

BMI was then calculated for each child by taking his/her body weight in kilograms and dividing it by his/her height in squared meters. BMI was assessed using the age- and sex-specific BMI calculator from the WHO (2007), AnthroPlus version 3.1. Waist circumference was measured to the nearest 0.1 cm using a measuring tape (Li et al., 2006). The child stood for this measurement, which was taken at minimal respiration (Li et al., 2006). The researcher palpated the hip for the right iliac crest and the measuring tape was placed horizontally at the high point of the iliac crest.

To assess general physical activity, I used the Canadian Health Measures Survey (CHMS) children's physical activity questionnaire (CPA) (Statistics Canada, 2010). The CPA is a 7-day recall that stated physical activity to be any activity that increases a person's heart rate, making that person occasionally out of breath or warmer than usual (Appendix D). The CPA had previously been tested for validity and reliability, was cost and time efficient, and also included two questions regarding the child's sedentary activities (Statistics Canada, 2010a). A variable was derived to examine physical activity in hours per day and compared to recommendations of at least 60 minutes per day for children (Canadian Society for Exercise Physiology [CSEP], 2011). Another variable was derived to examine sedentary activity in hours per day and compared to recommendations of less than two hours per day for children (CSEP, 2011). Based on the CHMS, two questions on sun exposure were also included at the end of this questionnaire (Statistics Canada, 2010a).

3.2.4 *Biomarkers of Disease*

Blood pressure measurements were taken three times in each child using a Nova Aneroid Sphygmomanometer produced by the American Diagnostic Corporation, Hauppauge, USA and a Littman Stethoscope-Classic II Pediatric, St. Paul, USA. A latex-free cuff was used in case a child had latex allergies. Following the National High Blood Pressure Education Program (NHBPEP) (2004) guidelines, the child sat quietly for five minutes prior to the measurement. During the measurement, the child was seated with his/her back supported, feet flat on the floor, and the right arm supported so the cubital fossa was at heart level. The right arm was always measured for consistency with standard values. The cuff bladder covered 80%-100% of the circumference of the child's arm and the stethoscope was placed over the brachial artery, proximal and medial to the cubital fossa, just below the bottom edge of the cuff (NHBPEP, 2004). The first blood pressure measurement was taken on the day of the DXA measurements. If the child was found to have a blood pressure greater or equal to the 95th percentile, a blood pressure measurement was taken when each of the second and third 24-hr recalls was administered. A child with a SBP or DBP measurement greater or equal to the 95th percentile on all three occasions was deemed hypertensive (NHBPEP, 2004). Children with blood pressures greater or equal to the 90th percentile and less than the 95th percentile were categorized as pre-hypertensive (NHBPEP, 2004). The hypertensive children were advised to seek appropriate medical attention.

Serum glucose was measured on site using a single drop of blood from the finger prick, discussed below, using the Accu-Chek® Aviva Nano glucometer produced by Roche Diagnostics, Mannheim, Germany (2011). The reference value for random capillary blood glucose was obtained from the American Diabetes Association (Pearson, Brolos, Herner, Hansen, & Olsen, 2007). Random capillary blood glucose was considered high if above 7.8 mmol/L (Pearson et al., 2007). Total blood cholesterol reference values were obtained from the American Heart Association (2011). Although universal screening of cholesterol in children is not recommended, it is included to give a general idea of cholesterol levels in newcomer children and was not used for diagnostic purposes (National Cholesterol Education Program (NCEP) Expert Panel on Blood Cholesterol Levels in Children and Adolescents, 1992). Acceptable cholesterol was any value less than 4.4 mmol/L while total cholesterol was considered borderline

if between 4.4-5.1 mmol/L and high if 5.2 mmol/L or greater (American Heart Association, 2011). Non-fasting total blood cholesterol was collected on the same blood spot cards provided by ZRT Laboratory, Beaverton, USA (2009) that were used to collect blood for the analysis of serum vitamin D, discussed below. The procedure involved enzymatic hydrolysis of cholesterol ester to cholesterol and free fatty acids in the presence of cholesterol-esterase. The cholesterol produced then underwent oxidation by cholesterol-oxidase to Cholestene-3-one and hydrogen peroxide. The indicator quinoneimine is formed from hydrogen peroxide and 4-aminoantipyrine in the presence of phenol and peroxidase. Peroxidase catalyzed the coupling of H_2O_2 with 4-aminoantipyrine and produced a quinoneimine dye that showed an absorbance maximum at 490 nm. The increase in absorbance at 490 nm was directly proportional to the cholesterol concentration of the sample (ZRT Laboratory, 2009).

Until recently, the measurement of vitamin D status had required access to 25–50 μ L of serum. However, a recently validated protocol described by Eyles et al. (2009), Eyles et al. (2009), and Newman et al. (2010) determined vitamin D status from dried blood spots (DBS) and was used in this study. Serum vitamin D levels were obtained using Varian 1200L liquid chromatography-tandem mass spectrometry (LC-MS/MS), modified to allow for automation (ZRT Laboratory, 2009). The majority of the blood spot tests were performed in April and May of 2010. The collection of DBS samples was straightforward and relatively non-invasive in comparison with venipuncture. The process entailed first cleaning the participant's finger with isopropyl alcohol, and then pricking the finger with a sterile, spring-loaded, disposable lancet. The first drop of blood was wiped away with a sterile pad and the subsequent blood drops were then transferred to each of eight 6 mm spots on a filter card and dried for thirty minutes. All samples were then sent to ZRT Laboratory for analysis. In a ZRT lab, the DBS were punched from the cards using a Wallac MultiPuncher from Perkin Elmer and reconstituted with 600 μ L of deionized water (ZRT Laboratory, 2009). The next step was to add 600 μ L of methanol-containing internal standard (D4-25-hydroxyvitamin D3) to precipitate proteins. The samples were then vortexed and 900 μ L of the supernatant was extracted with C18 solid phase extraction. Extracted samples were derivatized with 200 μ L of 0.1 mg/mL PTAD (4-phenyl-1,2,4-triazoline-3,5-dione) at room temperature for ten minutes. Derivatized samples were blown dry with nitrogen and reconstituted with 50 μ L of methanol and 20 μ L was injected into the LC-MS/MS system (ZRT Laboratory, 2009). Results were calibrated with standards provided by the

National Institute of Standards and Technology. Recent recommendations by the IOM (2010) dietary reference intake (DRI) panel on vitamin D were used for reference values to define vitamin D status including less than 30 nmol/L as deficient in vitamin D, 30-50 nmol/L as inadequate, and more than 50 nmol/L as sufficient.

Body composition was assessed using a DXA machine, Hologic Inc. Discovery-Wi, Bedford, USA, Serial #: 80964. All DXA measurements were conducted by a trained radiology technologist. This machine is safe for children as the radiation emitted from the machine is very low, equivalent to that obtained from a commercial airplane flight with duration of three hours (Ellis, 2002). All measurements required the participants to remove their shoes, jewellery, and other metals as the participants must not have any metal on their body for the DXA scan. Therefore, sweats and t-shirts were provided in different sizes for the participants, which were washed between uses. The child lay down on the whole body scanner with an x-ray underneath and a detector overhead. The test endured no more than 20 minutes for each child. After storing data on the DXA computer system, a printout was obtained from the radiology technologist and entered into the database for analysis. This study focused on TBBMC as the most accurate DXA bone mineral measure in children (Fewtrell, 2003). The coefficient of variation for TBBMC in our laboratory is 0.5%. Values obtained for TBBMC were compared to estimated normal values for each child's age, sex, and ethnicity based on data from four longitudinal studies: The University of Saskatchewan's Pediatric Bone Mineral Accretion Study, The University of British Columbia's Healthy Bones Trials, Penn State University's Young Women's Health Study, and Stanford University's Bone Mineral Accretion Study (Baxter-Jones & Mirwald, 2004). Although TBBMC was the focus of the DXA measurements, values for percent total body fat were also obtained. These values were compared to bioelectrical impedance analysis values from a study performed in the United Kingdom in the absence of DXA percent total body fat cut-offs in children (McCarthy et al., 2006).

3.2.5 Dietary Assessment

Three 24-hr dietary recalls were administered to each child and the average of the three was taken to obtain a usual intake (Appendix F). The first 24-hr recall was administered in person on the day bone and body measurements were conducted. The two subsequent 24-hr

recalls were also administered in person at least three weeks apart, rather than over the phone, to avoid potential language barriers. The researcher initiated the communication with participants by phone to arrange a meeting for the second and third 24-hr recalls. A trained graduate or senior undergraduate nutrition student conducted all dietary assessments.

Information gathered was entered into a diet analysis program “The Food Processor Nutrition and Fitness Software version SQL 10.5”, produced by Esha Research, Salem, USA. This program was chosen for its inclusion of more than 4,000 Canadian food items and corresponding nutrient values from the Canadian Nutrient File created by Health Canada. Consumption of homemade ethnic foods was common in participants. During administration of the 24-hr recalls, respondents were asked to break down meals or homemade food or beverages into specific ingredients so that the ingredient, its amount, and brand (if known) could be entered into the diet analysis program. If the exact food item was not found in the program, the USDA food item nearest it in terms of nutrient content was chosen. Necessary measures were taken to monitor and ensure the quality of the data. One person entered all 24-hr recalls to ensure consistency. A nutrition graduate student reviewed the entered data for possible errors in data entry. The final record was coded and saved in Food Processor.

In the next stage, nutrient intake data was exported to separate Excel spreadsheets for each individual. Then data from the three 24-hr recalls was averaged for each individual to obtain their usual intake of nutrients. In the quality control process, a few food items with unusually high or low values in specific nutrient(s) were detected, the sources of error in the Food Processor data bank were found, and data were corrected. Food Processor does not categorize foods from the Canadian Nutrient File into Canadian food groups. Therefore, to obtain accurate food group intake data, after an initial training process, four senior nutrition students were assigned to categorize foods from the recalls to food groups according to Eating Well with Canada’s Food Guide (Health Canada, 2007). A Nutrition professor with extensive knowledge of Canada’s Food Guide was consulted to ensure proper categorization for less common food items. Food items in each recall were categorized once and then a second time by a different person to minimize human error. Amounts in servings per day were used and kept to two decimal places for accuracy. All foods in each respective food group were added up once, and then again verified by a different person for accuracy. These values were then entered into an Excel spreadsheet and exported to the database for analysis.

I examined whether participants met Eating Well with Canada's Food Guide recommended servings for each of fruit and vegetables, dark green and orange vegetables, grains, whole grains, milk and alternatives, and meat and alternatives (Health Canada, 2007). A number of recommended servings is not available for oils and fats, instead a recommendation is made to include a small amount of unsaturated fat each day and limit the number of foods consumed that are high in saturated and/or trans fats (Health Canada, 2007). The prevalence of participants who were not meeting the recommended intake of each food group was obtained and comparisons were made between refugee and immigrant children. Regarding nutrients, total energy intake, fat, saturated fat, vitamin D, protein, sodium, folate (DFE), iron, and calcium were analysed in the same way. DRI values set by the IOM were used to determine prevalence of inadequacy for the above mentioned nutrients and can be found in Appendix I (Health Canada, 2010b).

To examine the overall nutrition status of participants, I used the Canadian version of the Healthy Eating Index (HEIC) (Garriguet, 2009). The HEIC has been validated and incorporates recommendations from Eating Well with Canada's Food Guide. The HEIC is based on 11 components categorized as either adequate or moderate components. The adequacy components were total vegetables and fruit, whole fruit, dark green and orange vegetables, total grain products, whole grains, milk and alternatives, meat and alternatives, and unsaturated fats. The moderation components were saturated fats, sodium, and "other food." The scoring system attributed a certain number of points to each component and points were distributed proportionately based on the recommendation for age and sex from Eating Well with Canada's Food Guide. The points for each component were then added up to provide a total score out of one hundred. A person's diet was classified as poor if their score was less than fifty, points ranging from fifty to eighty indicated their diet needed improvement and more than eighty points indicated a good quality diet.

In order to obtain the necessary components for the HEIC we calculated the number of servings for each food group including whole grains and dark green and orange vegetables. The number of servings of whole fruit and the percent kcal intake from "other foods" were also calculated. The average of the components from each of the three 24-hr recalls was then taken to obtain their usual intake from each food group. I was also able to get the usual intake of unsaturated fats, saturated fat, and sodium from the 24hr recalls. I then calculated individual

scores for each component based on the instructions from Garriguet (2009) (Appendix G). The final step was to add the scores of all of the components together to obtain the participants' overall scores and then classify their diets as good, needing improvement, or poor.

3.3 Data Analysis

Descriptive statistics were analysed by calculating the mean and standard deviation of variables of interest as well as the distribution of participants in various categories. Analyses were conducted using PASW Statistics 18 by Polar Engineering and Consulting, Chicago, USA. Data were tested for normal distribution using Shapiro-Wilk test. I used a two-sided independent Student's t test or non-parametric equivalent (Mann Whitney U-test, when it was needed) to investigate the differences in variables of interest between refugees and immigrants and between males and females. Pearson's chi square was used to analyse categorical variables. Finally, multivariate analyses (linear and logistic regression) were conducted to examine the association between factors on health outcomes of interest (vitamin D status, TBBMC and BMI), controlling for possible confounders. In all analyses, alpha was set at the level of 0.05. All data, when possible, was compared to Canadian published data.

3.4 Ethics

Ethics approval was obtained from the University of Saskatchewan Ethics Committee on Biomedical Research (Bio # 09-197; Appendix H). A biosafety permit was obtained from the University of Saskatchewan Workplace Safety and Environmental Protection to conduct the measurements in facilities in the Williams Building. I overcame some ethical issues in this study including drawing blood from children and communication problems that could have potentially affected participants' rights. In order to minimize the risk of drawing blood from children, I used the blood spot method, which involved only a pin prick on one finger as opposed to using a needle to take a vial of blood. Language barriers existed as the participants were immigrants and refugees who had recently come to Canada. I used interpreters when filling out the consent form (Appendix B) with the children's parents to ensure participants understood their rights and what

was being asked of them during the study. Interpreters were also used when data were collected at each testing station so all questions posed were understood.

4. RESULTS

Results are presented for immigrants, refugees, and all participants in the following six sections, separated according to socio-demographics, health status (includes BMI, physical activity, and others), biomarkers of disease (includes serum vitamin D among others), food security status, food group intake and HEIC, and nutrient intake.

4.1 *Demographics and Socio-economic Status*

Table 4.1 includes socio-demographic information for participants. The mean \pm SD age of participants was 8.9 \pm 1.4yrs, with no significant difference between immigrants (n=33) and refugees (n=39). There was also no significant difference in distribution of males (n=48) and females (n=24) according to immigration status (Table 4.1).

Table 4.1 Demographics and socio-economic status of participants

Characteristics	Immigrants n=33 (45.8%)	Refugees n=39 (54.2%)	All participants n=72 (100%)
Age (Mean \pm SD)	8.9 \pm 1.6	8.9 \pm 1.3	8.9 \pm 1.4
Sex			
Male	22 (66.7%)	26 (66.7%)	48 (66.7%)
Female	11 (33.3%)	13 (33.3%)	24 (33.3%)
Region of origin			
Middle Eastern	24 (72.7%)*	9 (23.1%)	33 (45.8%)
Asian	1 (3.0%)*	17 (43.6%)	18 (25.0%)
African	2 (6.1%)*	11 (28.2%)	13 (18.1%)
Latin-American	6 (18.2%)	2 (5.1%)	8 (11.1%)
Education			
Neither parent has secondary education	4 (12.1%)*	28 (71.8%)	32 (44.4%)
Main source of income			
Wages and salaries	26 (78.8%)*	21 (53.8%)	47 (65.3%)
Social assistance	7 (21.2%)*	18 (46.2%)	25 (34.7%)
Income level			
Lowest	16 (48.5%)	23 (62.2%)	39 (55.7%)
Length of stay in Canada in years (Mean \pm SD)	2.6 \pm 1.5	2.5 \pm 1.1	2.5 \pm 1.3

*Significant difference from refugees; for means a t-test was used and for categorical variables chi square was used

Mean \pm SD length of stay in Canada for all participants was 2.5 \pm 1.3 yrs with no significant difference among immigrants and refugees (Table 4.1). Study participants came from various regions and results showed a significantly higher number of Middle Eastern ($p=0.001$) immigrant participants and a significantly lower number of Asian ($p=0.001$) and African ($p=0.015$) immigrant participants compared to refugees (Table 4.1). No significant difference was observed among Latin-Americans according to immigration status. More refugee children were found to have neither parent with a secondary education compared to immigrants ($p=0.001$) (Table 4.1). A higher proportion of immigrant households obtained their main source of income from wages and salaries as opposed to refugees who obtained their main source of income from social assistance ($p=0.027$). After classifying income according to Statistics Canada's income categories (Table 3.1), the majority of refugees were in the lowest income category as were approximately half of immigrants (Table 4.1).

4.2 *Food Security Status*

Food security status was measured for households and values were also calculated for child food security, both found in Table 4.2. The prevalence of household food security was 45.9% for all participants including 61.5% for immigrants and 34.3% for refugees. A total of 47.5% of participants experienced moderate food insecurity while 6.6% were severely food insecure. The distribution of moderate food insecurity according to immigration status was 34.6% for immigrants vs. 57.1% for refugees. There were also 3.8% of immigrants and 8.6% of refugees who were severely food insecure. Child food security saw a moderate increase in food security to 50.9% compared to household food security. Only 1.6% of children were severely food insecure while 47.5% remained moderately food insecure. For immigrant children, 34.6% were moderately food insecure and 3.8% were severely food insecure. For refugee children, 57.1% were moderately food insecure and none were severely food insecure. After combining categories of moderate and severe food insecurity into one, there was a significant difference in distribution of household food security status between immigrants and refugees ($p<0.05$). However, there was not a significant difference in distribution of child food security according to immigration status.

Table 4.2 Food security status of participants

Characteristics	Immigrants n=26 (42.6%)	Refugees n=35 (57.4%)	All participants n=61 (100%)
Household Food Security			
Food Secure	16 (61.5%)*	12 (34.3%)	28 (45.9%)
Food Insecure	10 (38.5%)*	23 (65.7%)	33 (54.1%)
Child Food Security			
Food Secure	16 (61.5 %)	15 (42.9 %)	31 (50.8%)
Food Insecure	10 (38.5%)	20 (57.1%)	30 (49.2 %)

*Significant difference from refugees; chi square was used

In logistic regression analyses, after controlling for possible confounders including households with children under the age of five years, region of origin, parents' education level, income category, length of stay in Canada, and having more than two children in a household; immigration status was the only significant predictor of household food security (Table 4.3). Refugees were at a considerably higher risk of household food insecurity than immigrants. However, after controlling for those same confounders, in regards to child food security, length of stay in Canada and having more than two children in a household were significant predictors of child food security (Table 4.3). Although refugees had a greater risk of household food insecurity, when it comes to child food insecurity, immigration status was not a factor. As the duration of stay in Canada increased, the risk of food insecurity in children decreased. Further, children who lived in households that had more than two children were at a greater risk of being food insecure.

Table 4.3 Final model, logistic regression (food secure vs. food insecure)

	Odds Ratio	95% Confidence Interval	p-value
Household food security			
Immigration status	2.93	1.02-8.45	.046
Constant	.63		.244
Child food security			
Length of stay (yrs)	.64	.41-1.00	.048
One or two children	3.95	1.16-13.48	.028
Constant	1.15		.842

4.3 Health Status

General health characteristics are presented in Table 4.4. Percentile height (mean \pm SD) was less than the 50th percentile with no significant difference between immigrants and refugees.

Percentile BMI was categorized as normal, overweight, or obese according to WHO child classifications. The majority of children were found to have a normal BMI while 22.2% were overweight and 6.9% were obese (Table 4.4). No significant differences were found when comparing prevalence of overweight/obesity among immigrants and refugees. I found 5.6% of participants had a waist circumference at or above the 90th percentile, indicating they could be at greater risk of developing coronary artery disease in the future (Janssen et al., 2005). Percent BMI was also significantly correlated with trunk fat, percent trunk fat, total body fat, and percent total body fat.

Table 4.4 Health status of participants

Characteristics	Immigrants n=33 (45.8%)	Refugees n=39 (54.2%)	All participants n=72 (100%)
Height in cm (Mean±SD)	132.6±13.2	130.3±10.9	131.4±12.0
Percentile Height (Mean±SD)	49.7±31.1	42.6±30.8	45.8±31.0
Weight in kg (Mean±SD)	32.1±10.6	29.9±7.8	30.9±9.2
Percentile Weight (Mean±SD)	68.8±27.4	64.9±28.8	66.7±28.0
Percentile BMI (Mean±SD)	62.9±27.6	62.4±29.4	62.7±28.4
WHO criteria			
Normal	24 (72.7%)	27 (69.2%)	51 (70.8%)
Overweight	6 (18.2%)	10 (25.6%)	16 (22.2%)
Obese	3 (9.1%)	2 (5.1%)	5 (6.9%)
Waist circumference (Mean±SD)	63.4±9.6	61.7±6.9	62.5±8.2
Waist circumference ≥90 th percentile	2 (6.3%)	2 (5.1%)	4 (5.6%)
Physical activity in hrs/wk (Mean±SD)	13.1±5.4	12.0±3.7	12.5±4.6
Recommended level(≥60mins/d)	29 (87.9%)	34 (87.2%)	63 (87.5%)
Less than recommended level (<60mins/d)	4 (12.1%)	5 (12.8%)	9 (12.5%)
Sedentary activity in hrs/d (Mean±SD)	2.3±1.6	2.9±1.5	2.6±1.5
More than 2hrs/d	11 (33.3%)	19 (48.7%)	30 (41.7%)

For means a t-test was used and for categorical variables chi square was used

Results showed 87.5% of immigrant and refugee newcomer children were obtaining the recommended number of hours per day of physical activity (≥60 mins) according to the Canadian Society for Exercise Physiology (CSEP) (2011). However, many participants were spending too much time (>2 hrs/d) in sedentary activities, such as time spent watching television or movies, playing video games, or using the computer (Table 4.4).

4.4 *Biomarkers of Disease*

High random blood glucose levels were found in 7.2% of participants with no significant difference between immigrants and refugees (Table 4.5). High cholesterol levels (≥ 5.2 mmol/L) were found in 40.3% of participants. Refugee children were found to have higher serum cholesterol than immigrant children ($p=0.004$). Further, the number of refugee children with high cholesterol was more than twice that of immigrant children (Table 4.5). Children were considered hypertensive if their blood pressure was at or above the 95th percentile; this was true of 2.8% of participants for SBP and 4.3% for DBP. In total, only one participant had both high SBP and DBP. Only 20% of obese children had normal DBP while 26.3% of overweight and obese children were hypertensive. Total serum vitamin D (nmol/L) was significantly higher in immigrant compared to refugee children ($p=0.021$) (Table 4.5). I found that 29% of participants were vitamin D deficient and another 44% had inadequate levels of serum vitamin D for bone health according to the recently released recommendations by the IOM (2010). Children spent 3.6 ± 1.6 hrs/day (mean \pm SD) in the sun in the summer months during peak times (11:00am-4:00pm), which was consistent across immigration status. Results also showed that very few children always wore sunscreen whereas more than half of children never did (Table 4.5). In linear regression analyses, after controlling for possible confounders including total caloric intake, age, sunscreen use, total hours spent in the sun in the summer months during peak times, and calcium intake; dietary vitamin D intake, sex, region of origin, and length of stay in Canada were found to be significant predictors of serum vitamin D status (Table 4.6). Females and those who had been living in Canada longer had lower levels of serum vitamin D (Table 4.6).

The mean \pm SD TBBMC of all participants was 964.6 ± 224.9 g and 38.6% were found to have low TBBMC compared to estimated values for age, sex, and ethnicity (Baxter-Jones & Mirwald, 2004). In the regression model, after controlling for possible confounders including immigration status, food security, age, sex, region of origin, physical activity level, total caloric intake, calcium intake, magnesium intake, phosphorus intake, sodium intake, and caffeine intake; height and serum vitamin D status were found to be determinants of TBBMC (Table 4.7). Children who were taller and had greater serum vitamin D also had greater TBBMC (Table 4.7).

Table 4.5 Biomarkers of Disease

Characteristics	Immigrants n=33 (45.8%)	Refugees n=39 (54.2%)	All participants n=72 (100%)
Systolic Blood Pressure (SBP) (Mean±SD)	99.6±10.4	97.7±8.4	98.6±9.3
At risk percentile SBP			
Hypertensive (≥95)	0 (0.0%)	2 (5.1%)	2 (2.8%)
Pre-hypertensive (≥90-<95)	5 (15.6%)	1 (2.6%)	6 (8.5%)
Diastolic Blood Pressure (DBP)(Mean±SD)	64.0±7.7	63.6±7.3	63.8±7.4
At risk percentile DBP			
Hypertensive (≥95)	1 (3.1%)	2 (5.3%)	3 (4.3%)
Pre-hypertensive (≥90-<95)	7 (21.9%)	6 (15.8%)	13 (18.6%)
Random capillary blood glucose in mmol/L (Mean±SD)	5.9±0.7	6.2±1.1	6.1±0.9
High random capillary blood glucose (≥7.8 mmol/L)	1 (3.2%)	4 (10.5%)	5 (7.2%)
Blood cholesterol in mmol/L (Mean±SD)	4.6±0.7*	5.3±0.9	5.0±0.9
Borderline High ≥4.4 mmol/L	10 (34.5%)	10 (26.3%)	20 (29.9%)
High ≥5.2mmol/L	7 (24.1%)	20 (52.6%)	27 (40.3%)
Hrs/d spent in the sun during peak times (Mean±SD)	3.6±1.7	3.5±1.5	3.6±1.6
Sunscreen use			
always	0 (0.00%)	2 (5.1%)	2 (2.8%)
often	4 (12.1%)	0 (0.00%)	4 (5.6%)
sometimes	5 (15.2%)	10 (25.6%)	15 (20.8%)
rarely	3 (9.1%)	5 (12.8%)	8 (11.1%)
never	21 (63.6%)	22 (56.4%)	43 (59.7%)
Total serum vitamin D in nmol/L (Mean±SD)	45.7±13.9*	37.8±15.5	41.2±15.2
Deficient and insufficient<50nmol/L	19 (63.3%)	31 (79.5%)	50 (72.5%)
Sufficient >50nmol/L	11 (36.7%)	8 (20.5%)	19 (27.5%)
Total body bone mineral content (TBBMC) in grams (Mean±SD)	984.9±245.0	947.8±208.8	964.6±224.9
Low TBBMC	13 (41.9%)	14 (35.9%)	27 (38.6%)
Total body fat in grams (Mean±SD)	7758.2±4764.9	6937.4±3220.4	7307.4±3981.7
Percent total body fat (Mean±SD)	23.6±7.6	22.7±6.5	23.1±7.0
Obese ≥95 th centile	10 (31.3%)	11 (28.2%)	21 (29.6%)
Overfat ≥85 th centile	3 (9.4%)	6 (15.4%)	9 (12.7%)
Normal 2 nd >85 th centile	17 (53.1%)	20 (51.3%)	37 (52.1%)
Underfat <2 nd centile	2 (6.3%)	2 (5.1%)	4 (5.6%)
Trunk fat in grams (Mean±SD)	2727.2±2003.7	2446.3±1382.0	2572.9±1683.6
Percent trunk fat (Mean±SD)	19.1±7.6	19.0±6.8	19.1±7.1

* Significant difference from refugees; for means a t-test was used and for categorical variables chi square was used

Table 4.6 Factors associated with serum vitamin D in regression analysis (using the stepwise procedure) among all subjects (n=63)

Outcome variable	Constant	Regression coefficient				Total R ²
		Vitamin D (IU)	Sex	Region of origin	Length of stay (yrs)	
Serum vitamin D	46.09±7.33	.46±.11	-.39±.11	.24±.11	-.23±.11	.33
Partial R ²		.48	-.44	.29	-.27	
p-value		<.001	<.001	.027	.040	
Outcome variable	Excluded variables					
	Sunscreen use	Hrs in sun during peak times	Age	Calories (kcal)	Calcium (mg)	
Serum vitamin D	-.05	.14	-.14	-.17	.08	
Partial R ²	-.06	.17	-.17	-.19	.07	
p-value	.657	.210	.188	.155	.609	

Table 4.7 Factors associated with total body bone mineral content (TBBMC) in regression analysis (using the stepwise procedure) among all subjects (n=56)

Outcome variable	Constant	Regression coefficient				Total R ²
		Height (cm)	Serum vitamin D (nmol/L)			
TBBMC	-1257.33	.95±.06	.13±.06			.82
Partial R ²		.90	.27			
p-value		<.001	.047			
Outcome variable	Excluded variables					
	Sex	Region of origin	Age	Calcium (mg)	Calories (kcal)	Immigration Status
TBBMC	.01	-.09	-.12	.07	.07	.05
Partial R ²	.03	-.20	-.17	.13	.14	.12
p-value	.832	.147	.227	.353	.323	.408
Outcome variable	Excluded variables					
	Hrs/wk in physical activities	Food security	Magnesium (mg)	Phosphorous (mg)	Sodium (mg)	Caffeine (mg)
TBBMC	.02	.11	.06	.06	-.04	-.03
Partial R ²	.03	.23	.11	.11	-.08	-.06
p-value	.805	.095	.419	.434	.574	.660

Information regarding body fat measures was also obtained from DXA. Results showed 29.6% of participants were obese and 12.7% were overfat based on percent total body fat (Table 4.5). There was no significant difference in percent total body fat in immigrants vs. refugees

(Table 4.5). However, girls were found to have a significantly higher percent total body fat mass compared to boys ($26.2 \pm 6.0\%$ vs. $21.5 \pm 7.0\%$ respectively, $p=0.003$).

In logistic regression analyses, to examine determinants of overweight/obesity based on BMI, including sex, parent education, household food security, sedentary activity levels, serum vitamin D, total caloric intake, the HEIC score, immigration status, age, and region of origin into the model, only immigration status was a significant predictor of overweight/obesity (Table 4.8). Refugees had a considerably higher risk of being overweight/obese compared to immigrants (Odds Ratio=12.29, $p=0.39$). Compared to BMI, body fat measures allowed the specification of body fat only. All body fat measures were highly correlated with BMI. However, only centile cut-offs for percent total body fat were available to compute a categorical variable that defines overfat and obesity. Therefore, in order to determine the association between variables of interest and overweight/obesity, we repeated the regression analyses using percent total body fat as the outcome variable. Variables included into the model were sex, parent education, household food security, sedentary activity levels, serum vitamin D, total caloric intake, the HEIC score, immigration status, age, and region of origin; although region of origin was borderline, only immigration status was significantly associated with percent total body fat (Table 4.8). The results were consistent with the findings when BMI was used to define overweight and obesity (Table 4.8). Refugees and participants from the Middle-East were at risk of higher percent total body fat defined as overfat and obese.

Table 4.8 Final model, logistic regression (overweight/obese vs. normal)

	Odds Ratio	95% Confidence Interval	p-value
Body Mass Index (BMI)			
Constant	.000		.014
Immigration status	12.29	1.13-133.80	.039
Age	.39	.89-2.48	.133
Sex	-.13	.16-4.83	.878
Region of origin	1.35	.63-23.72	.144
Education	-1.51	.03-1.67	.143
Food security	.43	.32-7.40	.591
Sedentary activity	.93	.61-10.49	.204
Serum vitamin D	-.27	.13-4.70	.774
Calories (kcal)	.00	1.00-1.00	.663
Healthy Eating Index (HEIC)	1.12	.19-50.45	.434

Table 4.9 Final model, logistic regression (overfat/obese vs. normal/underfat*)

	Odds Ratio	95% Confidence Interval	p-value
Percent Total Body Fat			
Constant	.10		.377
Immigration status	13.09	1.44-119.37	.023
Region of origin	6.31	.98-40.70	.053
Age	.87	.55-1.39	.557
Sex	1.39	.30-6.54	.676
Education	.58	.11-3.11	.527
Food security	.69	.15-3.20	.638
Sedentary activity	.94	.26-3.39	.925
Serum vitamin D	1.17	.23-5.93	.846
Calories (kcal)	1.00	1.00-1.00	.498
Healthy Eating Index (HEIC)	6.71	.47-95.64	.160

*Using body fat centiles as cut-off values (McCarthy et al., 2006), only two participants were in the underfat category

4.5 Food Group Intake and the HEIC

Table 4.10 presents data on food group intake of participants and the HEIC. There was no significant difference in intake of food groups according to immigration status. The majority of participants were meeting Eating Well with Canada's Food Guide recommendations for servings of meat and alternatives (Table 4.10). Only 24.2% of participants met recommendations for milk and alternatives. While 50.0% met recommendations for grains, only 10.6% met recommendations for whole grains. Few participants met recommendations for servings per day of vegetables and fruit at 19.7% with only 13.6% meeting recommendations for dark green and orange vegetables. There was a significant difference in mean \pm SD HEIC scores between immigrants and refugees at 65.4 \pm 7.7 vs. 60.4 \pm 8.8 respectively (p=0.021). I found the majority of participants, 90.9%, had diets that needed improvement. Only one immigrant was categorized as having a good quality diet while none of the refugee children did. There were also five refugees who had poor diets while none of the immigrants had poor diets.

Table 4.10 Food group intake and the HEIC scores of participants

Characteristics	Immigrants n=33 (45.8%)	Refugees n=39 (54.2%)	All participants n=72 (100%)
Meat and alternatives			
Mean intake (servings/day)	2.2±1.1	1.7±0.9	1.9±1.0
Meeting Canada's Food Guide recommendations	28 (90.3%)	26 (74.3%)	54 (81.8%)
Milk and alternatives			
Mean intake (servings/day)	1.9±1.2	1.6±1.1	1.7±1.2
Meeting Canada's Food Guide recommendations	10 (32.3%)	6 (17.1%)	16 (24.2%)
Grains			
Mean intake (servings/day)	5.4±2.4	4.7±1.9	5.0±2.2
Meeting Canada's Food Guide recommendations	18 (58.1%)	15 (42.9%)	33 (50.0%)
Whole grains			
Mean intake (servings/day)	0.8±1.2	0.7±1.1	0.8±1.1
Meeting Canada's Food Guide recommendations	3 (9.7%)	4 (11.4%)	7 (10.6%)
Vegetables and fruit			
Mean intake (servings/day)	4.6±2.6	3.9±1.9	4.2±2.3
Meeting Canada's Food Guide recommendations	8 (25.8%)	5 (14.3%)	13 (19.7%)
Dark green and orange vegetables			
Mean intake (servings/day)	0.5±0.4	0.5±0.5	0.5±0.5
Meeting Canada's Food Guide recommendations	4 (12.9%)	5 (14.3%)	9 (13.6%)
Healthy Eating Index Canada			
Mean Score	65.4±7.7*	60.4±8.8	62.7±8.6
Good Diet	1 (3.2%)	0 (0.0%)	1 (1.5%)
Diet Needs Improvement	30 (96.8%)	30 (85.7%)	60 (90.9%)
Poor Diet	0 (0.0%)	5 (14.3%)	5 (7.6%)

* Significant difference from refugees; for means a t-test was used and for categorical variables chi square was used

4.6 Nutrient Intake

Nutrient intakes of participants are presented in two sections: i) macronutrients including total calories, calories from both fat and saturated fat, fat, saturated fat, protein, carbohydrate, fibre, and sugar and ii) micronutrients including folate (DFE), iron, sodium, zinc, vitamin B12, and calcium (Table 4.11). Information on nutrient intakes was gathered using three 24-hr recalls to obtain usual intakes of participants. There were six participants who did not complete all

three 24-hr recalls and they were, therefore, excluded from all analyses associated with food group intake, nutrient intake, and the HEIC. Prevalence of intake inadequacy was calculated for all nutrients of interest based on the DRI age and sex groups (Appendix I). Immigrant children had a significantly higher intake of total calories (kcal), caloric intake from fat and saturated fat, protein, carbohydrate, fibre, fat, saturated fat, folate (DFE), iron, sodium, and zinc (Table 4.11). There was no significant difference in consumption of sugar, calcium, or vitamin B12 between immigrants and refugees.

4.6.1 Macronutrients

The prevalence of protein intake inadequacy was only 3% for all participants. The prevalence of carbohydrate intake inadequacy was only 2% in all participants. Since the mean and median intakes of fibre for all participants were below the AI, nothing can be inferred regarding possible prevalence of inadequate intake for fibre. However, due to the large gap between the AI and mean and median intake of participants, we can speculate that participants may have been inadequate in fibre intake.

4.6.2 Micronutrients

The prevalence of folate (DFE) intake inadequacy was 33%. The prevalence of iron intake inadequacy was 9%. The prevalence of intake inadequacy of both folate (DFE) ($p=0.023$) and iron ($p=0.016$) was significantly greater among refugee children compared to immigrant children (Table 4.11). The prevalence of vitamin B12 intake inadequacy was 8%. The prevalence of zinc intake inadequacy was 27%. Since the prevalence of intake inadequacy was higher than expected for folate (DFE) and zinc, the intake of these nutrients was investigated further. Errors for the nutrient content of some foods high in folate (DFE) or zinc were found and corrected. For folate (DFE), an analysis of the amount of rice consumed vs. refined grains vs. whole grains was done to see if there was potentially a difference in consumption of rice, which is not high in folate (DFE) compared to other grains, which are high in folate (DFE). There was not a significant difference in rice consumption for those who had a prevalence of inadequacy in folate (DFE) compared to those who did not. For zinc, a comparison was done for

meats versus only alternatives. However, those who had a prevalence of inadequacy of zinc did not consume more meat alternatives, which have a lower zinc content than meat alone, compared to those who did not have a prevalence of inadequacy in zinc.

Mean \pm SD sodium intake was 2415 \pm 1267 mg/day while median intake was 2091 mg/day for all participants. Since the mean and median intakes of sodium are above the AI, it can be said that participants were consuming adequate amounts of sodium. Sodium intake above the UL was significantly greater in immigrants compared to refugees ($p=0.007$). Those participants above the UL were at risk of potential adverse effects, such as hypertension, due to excessive sodium intake. The prevalence of calcium intake inadequacy was 76%. Vitamin D intake from food and supplement was 213 \pm 195 IU (mean \pm SD) for all participants with a prevalence of inadequacy of 89.4%. Only two children reported taking a vitamin D supplement regularly, while only three participants sometimes did. There were also seven to ten participants who reported taking a multivitamin regularly. Vitamin D intake from food and supplement (Table 4.11) was significantly higher in immigrants compared to refugees, which accords with the significant difference in serum status (Table 4.5).

Table 4.11 Nutrient intake of participants

Nutrient intake/day (Mean ±SD)	Immigrants n=33 (45.8%)	Refugees n=39 (54.2%)	All participants n=72 (100%)
Total caloric intake in kcal	1949±580*	1480±467	1700±571
Caloric intake from fat in kcal	621±221*	473±165	542±206
Caloric intake from saturated fat in kcal	209±88*	159±55	182±76
Protein intake in g	69±21*	58±22	63±22
Carbohydrate intake in g	270±92*	196±67	231±88
Fibre intake in g	14±5*	11±4	13±5
Sugar intake in g	108±39	73±31	90±39
Fat intake in g	69±25*	53±18	60±23
Saturated fat intake in g	23±10*	18±6	20±8
Vitamin B12 intake in mcg	5±6	3±2	4±5
Prevalence of vitamin B12 intake inadequacy [n (%)]	1 (3%)	4 (11%)	5 (8%)
Folate intake, DFE	349±275*	237±106	290±210
Prevalence of folate intake (DFE) inadequacy [n (%)]	6 (19%)*	16 (46%)	22 (33%)
Calcium intake in mg	764±393	676±380	718±386
Prevalence of calcium intake inadequacy [n (%)]	23 (74%)	27 (77%)	50 (76%)
Vitamin D intake in IU (Mean±SD)	249±247	181±130	213±195
Prevalence of vitamin D intake inadequacy [n (%)]	25 (81%)*	34 (97%)	59 (89%)
Iron intake in mg	13±6*	10±11	11±9
Prevalence of iron intake inadequacy [n (%)]	0 (0%)*	6 (17%)	6 (9%)
Sodium intake in mg	2934±1524*	1956±747	2415±1267
Prevalence of sodium intake inadequacy [n (%)]	1 (3%)	6 (17%)	7 (11%)
Sodium intake above UL [n (%)]	8 (26%)*	1 (3%)	9 (14%)
Zinc intake in mg	10±5*	7±4	8±5
Prevalence of zinc intake inadequacy [n (%)]	5 (16%)	13 (37%)	18 (27%)

* Significant difference from refugees; for means a t-test was used and for categorical variables chi square was used

5. DISCUSSION

This study examined indices of health and nutrition status in immigrant and refugee newcomer children to Canada. Along with assessing demographics and socio-economic status as major determinants of health, I measured anthropometrics, bone and body measures, and biomarkers of diseases. The CPA questionnaire provided complementary information to the anthropometric measures. Questionnaires for food security and dietary assessment provided additional information on the nutrition status of participants. Finally, information collected on food groups and the HEIC provided a general overview on the nutrition status of immigrant and refugee children while information on nutrient intakes allowed a more in depth view. All of these markers of health status are discussed in detail below.

5.1 *Demographics and Socio-economic Status*

In 2008, Saskatchewan received 2% of Canada's immigrants, of which approximately 10% were in the age range of 7-11 years (Saskatchewan Statistical Immigration Report, 2008). The majority of participants in this study were in the lowest or lower-middle income categories (Table 4.1). I found that 62.2% of refugees and 48.5% of immigrants were in the lowest income category. This is slightly higher than what was reported from Canada's 2006 Census (Picot, Lu, & Hou, 2009). They found low income rates among recent immigrant families with children to be 42.4%, which is approximately three times higher than Canadian-born children at 14.8% (Picot et al., 2009). Here we see that refugees were more likely to be low income than immigrants, a distinction from this study that is not available from many others. The prevalence of low income rates decreased with length of stay in Canada; however, only reached that of the Canadian-born after 20 years (Picot et al., 2009).

The Saskatchewan Statistical Immigration Report (2008) reveals that more than 55% of immigrants to Canada have been found to have some form of post-secondary education. The study I conducted was able to delve further into education and distinguished refugees from immigrants. Education levels in refugee households were low and most parents had not graduated from high school. In contrast, the majority of immigrant children lived in households where at least one parent had a secondary school education. However, this did not mean their

parents were able to secure a job that correlated with their degree. Although information on type of employment was not collected, based on income levels and main source of income among participants' families, some inferences can be made. For example, many refugees were unemployed and living off financial assistance from Citizenship and Immigration Canada or social assistance, and immigrants had low paying (minimum wage) jobs, which was reflected by their income, as many experienced de-skilling post-migration. Looking back to the literature on reasons people migrate, the main reason is for a better life, which is associated with socio-economic status and job opportunities (Antecol & Bedard, 2006; McDonald & Kennedy, 2004). It seems, however, that the participants in my study, as newcomers with an average length of stay of 2.5 years in Canada, were not overly successful in these areas. This was mostly due to Canada not recognizing their credentials (de-skilling), which affects socio-economic status and thereby food security. Further, one study found that overall health, including mental health, was also affected and was associated with the healthy immigrant effect, which leads to poor health for newcomers within their first five years post-migration (Newbold, 2005).

5.2 *Food Security Status*

Food security is closely related to income (Che & Chen, 2001; Health Canada, 2011b). Therefore, it is not surprising that refugees were at greater risk of being food insecure compared to immigrants in this study. I found a difference in predictors of household food security compared to child food security. Immigration status was the only significant predictor of household food security, which indicated that for refugee families the odds of being food insecure was 2.9 times higher than immigrant families. However, when examining child food security, immigration status did not make a difference. Children were less likely to be food insecure the longer they had been in Canada and if they lived in a household with two or less children. Parents typically sacrifice themselves and will cut the size of their own meals or skip meals in order to make sure their children are getting enough food (McIntyre et al., 2003). However, when income is very limited, even though parents skip meals, they may still need to cut the size of their child's meals (McIntyre et al., 2003). This seems to be affected by the number of children in the household as it is harder to feed a greater number of children compared to fewer children (Health Canada, 2011b). Length of stay in Canada was a predictor of child

food security and could be linked to employment status and language ability. As length of stay increases, immigrants' and refugees' English (or French) language ability improves and they are able to secure a better job with higher pay and maybe even more health insurance (Health Canada, 2011b).

The CCHS 2008 found 7.5% of non-immigrant and 7.8% of non-recent immigrant households with children were food insecure (Health Canada, 2011b). At 12.6%, recent immigrants were at a considerably higher risk of being food insecure (Health Canada, 2011b). Prevalence of household food insecurity was considerably higher in this study for both immigrants and refugees (Table 4.2). Since food security is related to income and there were more immigrant participants in the lowest income category than Statistics Canada at 48.5% and 42.4% respectively, this may have affected the difference in prevalence of food insecurity. Here I only compared the immigrant participants as it has already been established that refugees are a completely different population with lower socio-economic status. The slight difference in income likely does not account for how I found approximately three times as many recent immigrants from this study who experienced food insecurity compared to the CCHS 2008. For this study, I used the same questionnaire as the CCHS. However, one nutrition graduate student who is well versed in food security among refugees administered each food security questionnaire, which resulted in greater consistency. The questions posed in the questionnaire are of a sensitive nature and some people are not comfortable talking about or admitting them to a researcher. For this study, both I and the research assistant who administered the food security questionnaire are avid volunteers in the community through one of Saskatoon's refugee and immigrant-serving organizations, Saskatoon Open Door Society. I also used interpreters from one of the organizations who also help newcomers get settled, take them to their doctor's appointments and interpret all the mail they receive. They had, therefore, already established a close communication with the participants. Due to the researchers' and interpreters' involvement in these communities, it is likely that there was a heightened sense of trust between the research staff and the participants. This would have made the participants more likely to respond truthfully to the food security questionnaire and is probably the main reason for the difference between my results and data from the CCHS.

I hypothesized that the nutritional status of newcomer children with household food insecurity would be poor compared to Canadian children. An article by Kirkpatrick & Tarasuk

(2008a) examined prevalence of inadequate intake of certain nutrients among Canadian children according to food security status. I used this study to compare my findings for protein, folate (DFE), iron, vitamin B12, and zinc as these were common nutrients between the two studies. For food insecure Canadian children, prevalence of inadequate intake of protein, folate (DFE), iron, vitamin B12, and zinc was less than 10% for the relevant age groups of 4-8 years and 9-13 years, except zinc in girls aged 9-13 years who had a prevalence of inadequate intake of 16% (Kirkpatrick & Tarasuk, 2008a). My results for newcomers regarding prevalence of inadequacy of protein and vitamin B12 were similar to Canadian children while that of iron was only slightly higher (Table 4.11). In this study, prevalence of inadequacy of folate (DFE) and zinc among food insecure newcomers was higher than Canadian children. Therefore, my hypothesis held true for the nutrients I was able to compare and the nutritional status of food insecure newcomers to Canada was poor compared to Canadian children as a whole. Since those who are food insecure also have a lower socio-economic status, not only do they have to rely on less food, but the food they do buy is cheaper and typically less nutritious.

5.3 *Health Status*

The rate of overweight and obesity in immigrant and refugee children was 29% compared to 26% of Canadian children aged 2-17 years (Shields, 2005). Research has shown that children who are overweight/obese are at greater risk of being overweight/obese in adolescence and adulthood and are also more likely to develop chronic diseases (Popkin, & Udry, 1998). BMI is affected by nutrition and physical activity and newcomers typically have better health upon arrival to Canada compared to the Canadian-born, an advantage that decreases with length of stay. Therefore, it is likely that prevalence of overweight and obesity will continue to rise as their length of stay in Canada increases. We can associate this decline in health with acculturation, especially rapid dietary acculturation and increasing sedentary activity levels. The prevalence of overweight/obesity in Canadian children is increasing at an alarming rate and is even slightly higher in refugee and immigrant newcomers, which calls for immediate action. Newcomer children are forced into a new environment where they are exposed to a different culture and lifestyle, including different foods and the propagation of many low-quality foods in the media. The government in Sweden took initiative to protect this vulnerable population from

negative exposure to the media by prohibiting advertisements targeted at children under the age of 12 (Magnusson et al., 2005). Quebec is the only province in Canada that has taken such action. Information regarding prevalence of overweight/obesity in immigrant and refugee children was lacking in the literature.

When it comes to nutrition, refugee children in particular come to Canada already at a disadvantage as their own parents may not have had nutrition education. This poses a larger problem with the array of food choices that are available and exposure to unhealthy foods through friends, other children at school, and the media. Parents need to know about nutrition as they are most often the ones who purchase food and make meals for their families. Even if children are exposed to some form of nutrition education in schools, many may not fully understand and may not relay that information to the rest of their family. Many immigrant and refugee families, particularly children, do not come to Canada with knowledge of the English or French languages and the concept of nutrition from a Canadian perspective (e.g., Canadian guidelines for healthy eating, food labelling, variety, and brand name vs. no name) may be new or unfamiliar.

Physical activity is an important contributor to overall health status. I hypothesized that newcomer children would have low levels of physical activity compared to Canadian-born children. Results showed that 88% of participants were meeting the new recommendations, set by the CSEP in association with the PHAC, of at least 60 minutes of physical activity per day (CSEP, 2011). Overweight/obesity was not statistically associated with physical activity in participants in my study, which could be due to an uneven distribution across BMI categories, although the CCHS 2.2 also found a lack of association between physical activity and BMI in children aged 6-11 years (Shields, 2005). Sedentary activity levels were not found to be significantly associated with overweight/obesity either. As of 2004, 36% of Canadian children were getting more than two hours per day of sedentary activity (Shields, 2005). Similar levels of sedentary activity were found among refugee and immigrant children (Table 4.4). Although the majority of participants were meeting recommendations for physical activity, it was only one hour per day, which can be done at school during gym class or recess. It is, therefore, easy to exceed the recommended two hours or less of sedentary activity each day.

5.4 *Biomarkers of Disease*

Biomarkers were used to examine the effects of overweight/obesity from dietary acculturation on various health outcomes. The biomarkers examined in this study were blood glucose, blood pressure, cholesterol, serum vitamin D, and TBBMC. Diabetes is more prevalent in South Asians, most likely due to genetic predisposition as well as other factors including insulin resistance, higher levels of visceral/abdominal adipose tissue, and diets high in fats and sugars (Misra & Ganda, 2007; Sohal, 2008). Although we had a small sample size, in this study, 40% of South Asians had high non-fasting blood glucose levels as opposed to only 20% in each of the Middle Eastern, Latin-American, and African regions of origin. High blood glucose was not significantly different in immigrants compared to refugees, so immigration status was not a factor, rather it is likely that region of origin was. Further investigation is needed to examine health outcomes according to ethnicity. Cholesterol levels were found to be higher in diabetics (Statistics Canada, 2010b). I found that 60% of participants who had high glucose also had high cholesterol, whereas 63.9% of participants who had normal glucose levels also had normal cholesterol.

I hypothesized that serum vitamin D status of newcomers would be inadequate and levels would be lower in refugees compared to immigrants. Results showed immigrant participants had greater serum vitamin D status and vitamin D intake compared to refugees. The majority (72.5%) of participants had serum levels that were deficient or inadequate. Mean serum vitamin D was higher in Canadian children aged 6-11 years (75.0 nmol/L), based on data from Statistics Canada (2011), compared to immigrants and refugees in this study (Table 4.5). Females, those who had been living in Canada longer, those with darker skin pigmentation, and those with lower vitamin D intake were at greater risk of vitamin D deficiency. It is not surprising to see that vitamin D intake was the main predictor of serum vitamin D. In this study, non-Caucasian immigrant and refugee children spent almost four hours a day outside during peak times in the summer months and the majority of participants rarely or never used sunscreen. This supports the hypothesis that those with darker skin pigmentation are at greater risk for deficiency as melanin in the skin prevents the body from synthesizing vitamin D (Nellen et al., 1996). It is likely that females were at greater risk of deficiency than males due to cultural practices which require females to keep themselves covered, therefore, females are not getting the necessary skin

exposure to the sun even though they may be outdoors (Nellen et al., 1996). It is more difficult to get the necessary vitamin D in areas of high latitude, especially during winter months (Grant & Holick, 2005; Hintzpeter et al., 2008; Mithal et al., 2009; van der Meer et al., 2006). This explains why those who had been in Canada longer were at greater risk of deficiency; vitamin D stores are depleted more and more each winter and are not replenished enough in the summer.

Pre-adolescence is the most important time for bone accrual (Caradonna & Rigante, 2009; Nichols et al., 2008). Newcomer children in this study were not getting the recommended amount of vitamin D for bone health. Inadequate levels impede proper bone growth which can result in stunting and increase the risk of developing osteoporosis in the future (Hintzpeter et al., 2008; IOM, 2010; Mithal et al., 2009). Serum vitamin D was a significant predictor of TBBMC in this study. Therefore, sufficient levels of serum vitamin D are important for the bone health of newcomer immigrant and refugee children to Canada. In addition to bone health, studies have also shown that vitamin D is associated with the prevention of chronic diseases including certain types of cancers, diabetes, and multiple sclerosis (Whiting & Calvo, 2005; Holick, 2011). No significant association was observed between nutritional status, physical activity and TBBMC. The TBBMC of participants in this study was similar to two other studies that examined BMC in boys and girls of similar age ranges; one study examined Caucasian Canadian children while the other looked at children in Copenhagen (Faulkner et al., 1996; Molgaard et al., 1997). A more recent Canadian study found significantly higher TBBMC values in Caucasian compared to Asian children (Burrows, 2009). There was no significant difference in TBBMC according to immigration status in this study. Further research with a larger sample size is needed to examine TBBMC in children according to ethnicity. When examining BMI, refugees were 12 times more likely than immigrants to be overweight/obese. However, BMI does not isolate body fat therefore other indicators of body fat were analysed. This study did find that immigration status along with regions of origin were predictors of percent total body fat. Refugees were 13 times as likely as immigrants to be overfat or obese and those originating from the Middle East were over six times more likely than participants from other regions of origin to be overfat or obese. However, caution should be used when interpreting this data due to the large confidence intervals of the odd ratios. Studies in larger scales are needed to examine this finding.

5.5 *Food Group Intake and the HEIC*

All food group intakes were compared to age specific recommendations according to Eating Well with Canada's Food Guide (Health Canada, 2007). The majority of participants met recommendations for meat and alternatives. Approximately half of participants met recommendations for grains and all did poorly in consumption of whole grains. Most participants did not meet recommendations for milk and alternatives. Garriguet (2007) found that 37% of Canadian children aged 4-9 years and 61% of boys and 83% of girls aged 10-16 years were not meeting recommendations for servings per day of milk and alternatives. I did not find a significant difference in distribution between the consumption of the recommended number of servings of milk and alternatives according to immigration status (Table 4.10). Participants' consumption of fruit and vegetables was also poor. Therefore, they were even further away from consuming the recommended servings per day of dark green and orange vegetables. Many Canadian children were not consuming the recommended number of servings per day of vegetables and fruit at 71% for those aged 4-8 years and 65% for those aged 9-13 years (Garriguet, 2007). Immigrants and refugees from this study consumed even less fruit and vegetables per day compared to Canadian children as a whole (Table 4.10). It is likely that participants were not meeting recommendations of food groups due to poor socio-economic status, food insecurity, rising food prices, exposure to new unfamiliar foods, or a lack of knowledge in the area of nutrition.

The HEIC gives a general overview of participants' nutrition status based on food group intake. Almost all participants scored in the category where their diets needed improvement. Data on Canadian children aged 2-11 years showed the mean HEIC score for immigrants was 66.6 vs. 63.9 for non-immigrants (Garriguet, 2009). The present study showed refugees had a significantly lower HEIC mean score than immigrants at 60.4 vs. 65.4 respectively. Only one immigrant participant was found to have a good diet and only refugees were found in the HEIC poor diet category (14%). Therefore, overall, refugees have a poor diet compared to immigrants and the Canadian-born. It is likely that immigrants have higher HEIC scores than refugees as immigrants have a greater socio-economic status and higher level of food security. They are, therefore, able to choose and purchase healthier food options for their families as well as a greater quantity of food. Since the diets of so many newcomer children were found to need

improvement, it is necessary to implement nutrition education programs to inform children and their parents of the importance of nutrition and physical activity in order to achieve healthy, active lifestyles.

5.6 *Nutrient Intake*

I hypothesized newcomer children who had been in Canada for less than five years would have poor nutritional status and a high rate of inadequate intake in major nutrients, particularly vitamin D, calcium, and protein and a high amount of sodium intake. I also hypothesized that these measures would be worse in refugee children compared to immigrant children. When examining nutrient intakes, I found refugees had a lower caloric intake and were consuming fewer nutrients than immigrants including protein, total carbohydrates, fibre, total fat, saturated fat, folate (DFE), iron, sodium, and zinc. This could be attributed to refugees typically having a lower income level and thereby lower HEIC scores and food security status. A lower intake of important nutrients by refugee participants could be associated with having less food, which is indicated by their lower total caloric intake.

Calcium, vitamin D, folate (DFE), and fibre are nutrients of particular concern for both immigrants and refugees. Calcium and vitamin D are important nutrients for bone growth, especially during pre-adolescence when bone mass accrual is at its highest (Caradonna & Rigante, 2009; Osteoporosis Canada, 2009b; Nichols et al., 2008). Low levels of these two nutrients align with the low consumption of milk and alternatives found in participants. I found immigrant and refugee newcomer children were consuming lower levels of calcium than Canadian children who were consuming 1063 mg/d (Table 4.11) (Health Canada, 2008a). Canadian children were consuming 254 IU/d of vitamin D, which was similar to my findings in immigrants (Table 4.11) (Health Canada, 2008b). However, there was even more concern for refugees who were consuming significantly lower amounts of vitamin D than immigrants (Table 4.11).

Folate (DFE) is found in many foods such as legumes, fortified grains, fruit and vegetables, especially dark green vegetables (Health Canada, 2011a). It is, therefore, difficult to attribute a prevalence of inadequacy to any one food group. Immigrants and refugees were consuming lower amounts of folate (DFE) than Canadians (458 DFE/d) (Table 4.11) (Health

Canada, 2008b). Fibre is found in whole grains as well as vegetables and fruit (Health Canada, 2011a). Results showed that those who consumed the recommended servings of whole grains also had higher mean fibre intake. Canadian children were consuming 15 g/d of fibre, which is slightly higher than immigrant and refugee children from this study (Table 4.11) (Health Canada, 2008a).

Sodium was a nutrient of concern for immigrants alone in this study as 26% were consuming amounts above the UL. However, recent immigrants were still consuming a mean sodium intake that was lower than Canadians (3259 mg/d) (Table 4.11) (Health Canada, 2008a). Higher levels of sodium in immigrants compared to refugees could be associated with greater dietary acculturation. Immigrants acculturate at a faster rate than refugees due to greater socio-economic status and English language ability (Barimah & van Teijlingen, 2008). Dietary acculturation is associated with the incorporation of a Western diet and elimination of cultural foods (Kittler & Sucher, 2008; Satia-Abouta et al., 2002). Therefore, it is likely that those who are experiencing a higher rate of dietary acculturation are consuming more fast food and pre-packaged food, which are high in sodium and fat. Immigrant and refugee children are of concern as the acculturation process occurs at a faster rate in children compared to adults (Kaushal, 2009).

Along with a high prevalence of inadequacy in calcium, vitamin D, folate (DFE) and fibre, for refugees alone in this study, nutrients of concern included iron and zinc. Canadian children consumed 15 mg/d of iron, which is higher compared to newcomers in this study (Table 4.11) (Health Canada, 2008b). I found that refugees who had a prevalence of inadequate intake of iron had a significantly lower intake of total calories, most likely due to a lack of appetite. Inadequate intake of zinc is associated with a loss of appetite, which can lead to anaemia. Children in this study who had an inadequate intake of zinc also had a significantly lower caloric intake, possibly associated with a loss of appetite. Results showed that immigrants consumed a significantly higher amount of zinc compared to refugees and both consumed less than Canadians (11 mg/d) (Table 4.11) (Health Canada, 2008b).

I hypothesized that poor nutritional status and a low level of physical activity in newcomer children are associated with poor health outcomes (i.e., overweight and obesity and low TBBMC). Overweight/obesity was not significantly associated with the HEIC or physical

and sedentary activity levels. No significant relationship was found between food and nutrient intake and physical activity with TBBMC. Only serum vitamin D was a predictor of TBBMC.

The ‘healthy immigrant effect’ and the interaction paradigm discuss self-perceived health, healthcare access, acculturation, and the interaction of migration factors. Self-perceived health could be higher upon migration to a new country (Antecol & Bedard, 2006; McDonald & Kennedy, 2004). For immigrants, they are optimistic and ready to start a new life and provide for their families. For refugees, their families are safe, they have food and shelter and their health has likely improved from what it was in the refugee camps. However, for both immigrants and refugees, as time passes, they are exposed to a new culture and begin comparing their health and lifestyle to the Canadian-born (Kopec et al., 2001; McDonald & Kennedy, 2004; Newbold, 2005). Perhaps they are not achieving the goals they had set for themselves in their new country, most likely due to the extensive barriers they must face including language, perceived discrimination, poor socio-economic status, and de-skilling (Newbold, 2005). All of these factors affect quality of life and health status (Ku, 2007). As newcomers, especially children, adjust to their new lives, they go through the process of dietary acculturation. Rapid dietary acculturation in children who move to developed countries such as Canada results in poor dietary choices leading to a host of health issues, which were covered throughout this study.

Compared to Canadian-born children, we have seen that newcomer children to Canada have lower socio-economic status, higher rates of food insecurity, and poor nutritional intake. There were some indices of health where immigrant children’s health status was similar to that of the Canadian-born or better, however, the literature shows us that this health advantage will not last as their length of stay in Canada increases (Gushulak, 2007; Kopec et al., 2001; Newbold, 2005). It is also important to note that the health status of refugee children is worse than immigrants and the Canadian-born.

5.7 Challenges and Limitations

One limitation of this study is the small sample size. However, since a comprehensive study on the nutrition and health status of newcomer children does not exist to my knowledge, this pilot study could provide valuable insight into this area. The small sample size resulted in uneven distribution across some of the categorical variables such as BMI and region of origin.

Another limitation was that of language. For the majority of participants, English was not their first language. Many participants could not speak English very well. In order to overcome this obstacle and ensure participants were aware of their rights, I arranged for interpreters for participants who needed them prior to the test day and in many cases interpreters were used to arrange the appointments. The use of interpreters was still a limitation as some words could have been lost in translation or could have been changed if a direct translation was not available, which could have resulted in the translated words meaning two different things in the two languages. For refugees, interpreters were coordinators from Saskatoon Open Door Society who know the participants very well. However, for immigrants who needed interpretation, they may have been hesitant to provide honest information regarding income, food security, or health issues to someone from their community. Transportation was also difficult for most people to arrange. Transportation services were therefore arranged to and from the testing site so that this would not limit who could participate. Since this study examined health indices in young children, it was mandatory for a parent/guardian to be present, preferably whoever did the grocery shopping and knew most about what the child ate. The parent was used as a proxy when the child was answering questionnaires to ensure accuracy and also was the main respondent for the socio-demographic and food security questionnaires.

Whenever questionnaires are administered, there is always a possibility of participants withholding information or providing the wrong information as self-reported data is dependent on memory. Some of the limitations for the 24-hr recalls that were administered for the dietary assessments included under-reporting/over-reporting, omission of frequently forgotten items such as beverages, sauces and other additives such as oil and salt. In order to help participants provide accurate information, I used the same food model booklets as were used in the CCHS Cycle 2.2, 2004. I also had measuring cups and spoons to assist people with estimates. For the majority of participants and interpreters, English was not their first language. I, therefore, had colour pictures for various food items such as cereals, vegetables and fruit, juice boxes, etc. to help people if they could not recall the name of a food item. Once people had reported one meal and again at the end of the recall, I would probe for the frequently forgotten food items. The 24-hr recall was administered at two in-person follow-up appointments to ensure a usual intake was obtained. Therefore, in my analyses, I included only those participants who had completed three recalls.

Length of stay in Canada and region of origin were also examined in all participants. Since the sample size was small, I was unable to look at length of stay in Canada according to each consecutive year in Canada in relation to other variables of interest. Participants were categorized according to self-identified ethnicity into one of four regions of origin: African, Asian, Latin-American, or Middle Eastern. Distribution across regions of origin was uneven which, in addition to the small sample size, made it difficult to assess region of origin in relation to other variables.

5.8 *Recommendations for Future Research*

Years of research have gone into trying to explain the decline in health seen in newcomers through theories such as the ‘healthy immigrant effect’ and the interaction paradigm. All evidence related to the ‘healthy immigrant effect’ is based on studies that examined adults and not children. Newcomer children in this study experienced many avoidable health issues that might develop into chronic conditions in the future. Longitudinal studies in larger scales are needed to evaluate changes over time regarding the health status of newcomer children in Canada. I also strongly recommend that studies distinguish refugee children from immigrant children.

Along with the need for more research in this area, there is a clear need to create change through the implementation of disease prevention programs in newcomer children. Programs would be particularly beneficial in the pre-adolescence ages as this is the time when children are most likely to adhere to healthy lifestyle behaviours. Pre-adolescence is also important since it is the time when major changes in body composition such as peak bone mass acquisition, fat mass distribution and others occur due to puberty. Such behaviours are more likely to persist throughout adolescence and adulthood if implemented at this time. Collaboration is needed between various government and non-governmental organizations to intervene in these two vulnerable populations and make an effort to promote healthy lifestyles and prevent the rising trend of chronic diseases.

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[consumers/vitamin-d-testing.html](http://www.zrtlab.com/health-care-consumers/vitamin-d-testing.html)

APPENDIX A



Study recruitment

Nutrition and health issues among newcomer children

Investigators: Dr. Hassan Vatanparast & Christine Nisbet, College of Pharmacy & Nutrition, University of Saskatchewan

Main Objectives:

1. To characterize nutritional status of newcomer children and identify the prevalence of inadequacy in important nutrients.
2. To determine the association between nutrition and physical activity with bone and body measures in newcomer children.

If you are a new immigrant/refugee, moved to Saskatoon within the last five years and have a child in the age range of 8-10 years, we invite you to participate in this study which takes approximately one hour. An honorarium will be provided to compensate your time.

Procedure: Assessments will be conducted in children and a parent.

1. In your child:

- a. Dietary intake and leisure time physical activity assessments using questionnaires
- b. Height and weight measurements
- c. The adequacy of vitamin D level in the body
- d. Bone and body composition measurement using a safe procedure that uses very low doses of x-ray (DXA scan).

2. At family level:

- a. Assessment of availability, accessibility and usage of food using a short questionnaire
- b. Socio-economic status assessment using questionnaire

To participate in the study or for more information contact:

1. Christine Nisbet at cnn914@mail.usask.ca or Phone: **966-1305 (NHNC study)**
2. Dr. Hassan Vatanparast at vatan.h@usask.ca, or Phone at **966-6341**
Please call during office hours (9:00am to 5:00pm), Monday to Friday.

If you are interested in participating in the study, please provide multiple dates (March 1st-May 31st) and times (5:00pm-8:00pm Mon-Thurs or anytime Fri-Sun) that are convenient for you.

APPENDIX B

Research Participant Information and Consent Form

TITLE: Nutrition and health issues among newcomer children in Saskatchewan

PRINCIPAL INVESTIGATOR: Dr. Hassan Vatanparast, Assistant Professor

Hassan Vatanparast, MD, PhD,
Assistant Professor,
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Tel 306-966-6341, Fax 306-966-6377
Email: vatan.h@usask.ca

Student Researcher: Christine Nisbet (MSc student) from the College of Pharmacy & Nutrition, U of S.

INTRODUCTION

You are invited to take part in this study on nutrition and health issues among newcomer immigrant and refugee children in the age range of 7-11 years, in Saskatoon. Your participation is entirely voluntary, so it is up to you to decide whether or not you wish to take part. If you choose to not take part, you do not have to provide a reason and it will not affect your care, your rights to any services or relationships with service providers or your relationship with any of the researchers. If you decide to take part in this study, you are still free to withdraw at any time and without giving any reasons for your decision.

This consent form may contain words that you do not understand. Please ask the researcher or the study staff to explain any words or information that you do not clearly understand. You may ask as many questions as you need to understand what the study involves. Please feel free to discuss this with your family, friends or family physician. If you agree to take part in this research study, you need to sign this form. Your signature means that you are willing to take part in this study.

Participation in this study is voluntary with no consequence whatsoever should you or your child choose to not participate.

STUDY PURPOSE

The overall goal of this study is to assess nutritional status and leisure time physical activity levels of newcomer children and their association with bone and body composition.

TIME REQUIRED TO PARTICIPATE

The total time requirement for participation is approximately 2.5-3 hours in the first visit and two 20 minute periods for phone recall or in-person interview for additional dietary assessments. Transportation will be provided to the study participants, if required.

STUDY PROCEDURES

1. Usual dietary intake of your child will be obtained. You will be asked to help your child recall what he/she ate and drank in the last 24-hours. This information will be obtained using a questionnaire, which will need to be completed on three occasions, three weeks apart. This questionnaire will take around 20 minutes to complete each time and depending on your familiarity with the English language, you will be invited for in person or phone interviews for the two follow-up dietary recalls.

2. Next, both household and child food security will be assessed using a questionnaire. Food security is a concept that identifies that everyone has a right/need to have access to safe and nutritious food for a healthy and active life.

3. Height and weight of your child will then be measured. Blood pressure will be taken by placing a cuff around your child's arm, which will inflate with air while a researcher listens to his/her heart beat. Blood glucose levels and vitamin D levels will also be assessed. For this, the inside tip of the middle or ring finger of the non-dominant hand will be pricked with a lancet to obtain a few drops of blood for testing. This procedure will be done by a researcher who is trained to take blood using the finger prick method. The procedure is safe and will only take a few minutes to complete. Your child may feel pain at the time of the finger prick, however, this test is important to determine bone health as vitamin D plays a role in preventing such diseases as osteoporosis, diabetes, and some forms of cancer.

4. A physical activity questionnaire will then be completed. This will also include questions that deal with sun exposure and will take no more than 20 minutes to complete.

5. Your child's whole body bone mineral content and density, and body composition will be measured using a DXA scan. The procedure takes place in a private room at the College of Kinesiology facilities in the William's Building. This part takes approximately 20 minutes to complete.

BENEFITS

If you choose to participate in this study, you will receive a brief report on the nutritional status of your child with some general recommendations on how to improve your child's nutritional status. If you wish, you will be provided with images of your child's DXA scans, which include data of your child's bone and body composition. This information cannot be used for diagnostic purposes of osteoporosis or any other diseases. It is hoped that the information gained from this study can be used in the future to enhance nutrition and health status of newcomer children.

RISKS AND DISCOMFORTS

There are minor health risks with this study related to the small amounts of radiation needed to obtain images during the DXA scan. The radiation dose is minimal (0.01 mSv), when compared to the amount of natural background radiation the average person is exposed to every day.

COST AND REIMBURSEMENTS

You will not be paid for participating in this study. An honorarium of {\$20.00 } will be provided to cover your time and out-of-pocket expenses such as travel, parking or meals. If you decide to withdraw early from this study, your compensation will be proportional to your time in the study. Also, transportation will be provided for you and your child, if required.

CONFIDENTIALITY AND LEGAL RIGHTS

The researchers will keep your personal information confidential. Your name and other information that can identify you will not be used at all in the study records. Instead, a special number will be used. Your child study record includes the results from the questionnaires, blood tests for vitamin D and DXA scan. This information will be kept for about 5 years in a locked cabinet in Dr. Vatanparast's office at the College of Pharmacy and Nutrition. Your information and the results of the study will also be recorded in a computer database. Only the investigators will have access to your study records, and know your name. No other people or groups will have access to the data or your information. The results of this study will be presented in a scientific meeting and published in a scientific journal, but your identity will never be revealed.

VOLUNTARY WITHDRAWAL FROM THE STUDY

You and your child do not have to be in this study. The choice to participate or not is up to you. If you do decide to take part in this study, you are still free to withdraw at any time and without giving reasons for your decision and without any negative effect. If you choose to enter the study and then decide to withdraw at a later time, all data collected about you during enrolment in the study will be retained for analysis up to the point of your withdrawal.

AFTER COMPLETION OF THE STUDY

After your participation, you will be provided with a summary of your child's dietary assessment results, and bone and body composition in comparison with standard values for his/her age and sex group. These comparisons are made with data collected at the national level so you will be able to compare your child's results with Canada's norms. General recommendations based on the results of the study objectives will be emailed [or mailed if no email available] to you if you wish to receive this information.

CONTACT INFORMATION

If you have any questions about this study or your care/treatment or desire further information about this study before or during participation, you can contact Hassan Vatanparast by emailing vatan.h@usask.ca or calling (306) 966-6341. Collect calls will be accepted.

If you have any questions about your rights as a research subject or concerns about the study, you should contact the Chair of the Biomedical Research Ethics Board, c/o the Research Ethics Office, University of Saskatchewan, at 306-966-4053. Collect calls will be accepted.

This study has been reviewed and approved on ethical grounds by the University of Saskatchewan Biomedical Research Ethics Board. The Research Ethics Board reviews human research studies. It protects the rights and welfare of the people taking part in those studies.

CONSENT TO PARTICIPATE

I have read (or someone has read to me) the information in this consent form. I understand the purpose and procedures, as well as the possible risks and benefits of the study. I was given sufficient time to think about the study and had the opportunity to ask questions to which I received satisfactory answers.

I am free to withdraw from this study at any time for any reason and the decision to stop taking part will not affect any services I am currently receiving or wish to receive in the future. I agree to follow the instructions of the research team.

I voluntarily consent for me and my child to take part in this research study and give permission to the use and disclosure of my de-identified personal health information collected for the research purposes described above.

By signing this document I do not waive any of my legal rights. I will be given a signed copy of this consent form.

_____/_____/_____
Printed Name of Participant Signature Date/Month/Year

_____/_____/_____
Name of person obtaining consent Signature Date/Month/Year

E-mail address (if applicable)

I wish to receive the results of this study: Yes / No (Please circle one)

I consent to be contacted in the future about further participation: Yes / No (please circle one)

Assent

The subject (child aged 7-11) who has the capability of understanding the purpose, procedures, risks and benefits of the study has had the study explained to him/her in the presence of his/her parent and/or guardian and he/she has given verbal assent to participate.

☐ Assent completed ☐ Assent Not applicable

Name of Person obtaining assent of the child:

Signature of Person obtaining assent of the child:

PHOTOGRAPHIC CONSENT

By signing this form,

I agree to allow my child to be photographed. These photographs will be used for educational and research dissemination purposes (during scientific presentations).

I understand that both I and my child have the right to refuse to provide photographs for use in this study. We also have the right to withdraw from this part of the study at any time, e.g., before or even after the photographs are taken. My decision will not affect my child's health care or our services/relationships with any organization or person.

I am free now, and in the future, to ask questions about the taking or use of the pictures of my child.

I understand that the pictures of my child will not be given to anyone other than the research team and will only be shown to others during scientific presentations and no information will be otherwise published without first asking my permission.

My signature below indicates that **"I agree, or consent, to having my child's picture taken as part of the study"**.

Printed Name of Child Child's signature of assent

Printed Name of Parent/Legal Guardian Parent/Legal Guardian signature & date

Printed Name of person who explained consent Signature & date

Printed Witness' name Witness' signature & date (subject does not read English)

MEDICAL HISTORY

Prior to your participation in the study, a few questions must be answered regarding your child's medical history.

1) Has your child ever broken a bone? If so, which one/ones?

2) Does your child take any medications or supplements relevant to bones (ie. vitamin D or calcium supplements)?

3) Has your child ever been treated for malnutrition? If so please list and explain the treatment given.

APPENDIX C

Socio-demographic Questionnaire

Subject and his/her mother will be invited for the interview. Mother will be the main person who answers the questions unless it is mentioned. In the absence of mother, parent/guardian will participate in the interview.

First Name:

Last name:

Home Address:

Phone number:

First name of subject's mother:

Last name of subject's mother:

Total number of individuals in the household:

Number of children in household:

Age and sex of children including the study participant:

Circle the position of study participant in terms of his/her chronological age in an ascending order

Child 1	Child 2	Child 3	Child 4	Child 5
Age	Age	Age	Age	Age
Sex	Sex	Sex	Sex	Sex

Add more columns if it is needed.

Age/sex of participant

(Mother/parent will assist in answering the questions)

1. (child) What is your date of birth (M/D/Y)?

Participant's Date of Birth:

Participant's Calculated Age (must be between 8 and 10 years old):

Participant's Sex:

2. (Mother) what is your date of birth (M/D/Y)?

Mother's/parent's Date of Birth:

Mother's/Parent's Calculated Age:

Socio-demographic characteristics (SDC)

Now some general background questions which will help us compare the health of immigrants in Canada. (Questions will be asked from the mother/parent)

3. Are you a refugee or an immigrant?
4. In what country were you born?
5. When did you arrive to Canada?
6. In what year did you first come to Canada to live (must have lived in Canada less than 5 years)?
7. To which ethnic or cultural groups did your ancestors belong? (For example: French, Scottish, Chinese, East Indian)
8. People living in Canada come from many different cultural and racial backgrounds. Are you:
White ☐ Chinese ☐ South Asian (e.g., East Indian, Pakistani, Sri Lankan) ☐
Black ☐ Filipino ☐ Latin American ☐
Korean ☐ Japanese ☐ Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese) ☐ Arab ☐ West Asian (e.g., Afghan, Iranian) ☐
9. What languages do you speak?
10. What language do you speak most often at home?
11. What is the language that you first learned at home?
12. Can you still speak and understand that language?

Education (EDU)

Now I'd like you to think about the rest of your household. Mother/parent will answer the following questions.

13. What is the highest grade of elementary school your child (subject) has completed?
14. What is the highest level of education the male head of household has attained (high school, college/university)?
 - 14.1 Has he received any other education that could be counted towards a degree, certificate or diploma from an educational institution?
 - 14.2 What is the highest degree, certificate or diploma he has obtained?

14.3 Is he currently attending a school, college or university? If so, is he a full or part time student?

15. What is the highest level of education you (mother) have attained (high school, college/university)?

15.1 Have you received any other education that could be counted towards a degree, certificate or diploma from an educational institution?

15.2 What is the highest degree, certificate or diploma you have obtained?

15.3 Are you currently attending a school, college or university? If so, are you a full or part time student?

Income (INC)

Although many health expenses are covered by health insurance, there is still a relationship between health and income. Please be assured that, like all other information you have provided, these answers will be kept strictly confidential.

16. Thinking about the total income for all household members, from which of the following sources did your household receive any income in the past 12 months?

Wages and salaries ☐ Income from self-employment ☐ Dividends and interest (e.g., on bonds, savings) ☐ Employment insurance ☐ Worker's compensation ☐ Retirement pensions, superannuation and annuities ☐ Old age security and guaranteed income supplement ☐ Child tax benefit ☐ Provincial or municipal social assistance or welfare ☐ Child support ☐ alimony, other (e.g., rental income, scholarships) ☐

17. What was the main source of income?

18. What is your best estimate of the total income, before taxes and deductions, of all household members from all sources in the past 12 months?

19. Can you estimate in which of the following groups your household income falls?

Was the total household income from all sources:

less than \$5,000 ☐

\$5,000 to less than \$10,000 ☐

\$10,000 to less than \$15,000 ☐

\$15,000 to less than \$20,000 ☐

\$20,000 to less than \$25,000 ☐

\$25,000 to less than \$30,000 ☐

\$30,000 to less than \$40,000 ☐

\$40,000 to less than \$50,000 ☐

\$50,000 to less than \$60,000 ☐

\$60,000 to less than \$80,000 ☐

\$80,000 to less than \$100,000 ☐

\$100,000 or more ☐

APPENDIX D

Children's Physical Activity (CPA)

Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. It can be done in sports, school activities, playing with friends, or walking to school. Some examples of physical activity are running, brisk walking, dancing, swimming, rollerblading, skateboarding, biking, soccer, basketball and football.

For these first two questions, add up all the time you spend doing physical activity each day.

1. Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?

- None (zero days) ☐
- 1 day ☐
- 2 to 3 days ☐
- 4 days or more ☐

2. Over a typical or usual week, on how many days are you physically active for a total of at least 60 minutes per day?

- None (zero days) ☐
- 1 day ☐
- 2 to 3 days ☐
- 4 days or more ☐

3. About how many hours a week do you usually take part in physical activity (that makes you out of breath or warmer than usual) in your free time at school (for example, at lunch)?

- Never ☐
- Less than 2 hours per week ☐
- 2 to 3 hours per week ☐
- 4 to 6 hours per week ☐
- 7 or more hours per week ☐

4. About how many hours a week do you usually take part in physical activity (that makes you out of breath or warmer than usual) in this class time at school?

- Never ☐
- Less than 2 hours per week ☐
- 2 to 3 hours per week ☐
- 4 to 6 hours per week ☐
- 7 or more hours per week ☐

5. About how many hours a week do you usually take part in physical activity (that makes you out of breath or warmer than usual) outside of school while participating in lessons or league or team sports?

Never ☐

Less than 2 hours per week ☐

2 to 3 hours per week ☐

4 to 6 hours per week ☐

7 or more hours per week ☐

6. About how many hours a week do you usually take part in physical activity (that makes you out of breath or warmer than usual) outside of school while participating in unorganized activities, either on your own or with friends?

Never ☐

Less than 2 hours per week ☐

2 to 3 hours per week ☐

4 to 6 hours per week ☐

7 or more hours per week ☐

7. On average, about how many hours a day do you watch TV or videos or play video games?

Don't watch TV or videos or play video games ☐

Less than 1 hour a day ☐

1 to 2 hours a day ☐

3 to 4 hours a day ☐

5 to 6 hours a day ☐

7 or more hours a day ☐

8. On average, about how many hours a day do you spend on a computer (working, playing games, e-mailing, chatting, surfing the Internet, etc.)?

Don't watch TV or videos or play video games ☐

Less than 1 hour a day ☐

1 to 2 hours a day ☐

3 to 4 hours a day ☐

5 to 6 hours a day ☐

7 or more hours a day ☐

Sun Exposure (SEB)

The next two questions are about your exposure to the sun. For these questions, think about a typical weekend or day off from school in the summer months.

1. About how much time each day do you spend in the sun between 11 am and 4 pm?

None ☐

Less than 30 minutes ☐

30 to 59 minutes ☐

1 hour to less than 2 hours ☐

2 hours to less than 3 hours ☐

3 hours to less than 4 hours ☐

4 hours to less than 5 hours ☐

5 hours ☐

2. In the summer months, on a typical weekend or day off from school, when you are in the sun for 30 minutes or more, how often do you use sunscreen?

Always ☐

Often ☐

Sometimes ☐

Rarely ☐

Never ☐

APPENDIX E

Food security (FSC) Questionnaire

The following questions are about the food situation for your household in the past 12 months.

1. Which of the following statements best describes the food eaten in your household in the past 12 months, that is, since [current month] of last year:
 - a) Have you and the other members of your household always had enough of the kinds of food you wanted to eat?
 - b) Have you and the other members of your household had enough to eat, but not always the kinds of food you wanted?
 - c) Have there been some times when you and the other members of your household have not had enough to eat?
 - d) Have you and the other members of your household often not had enough to eat?

The next several statements may be used to describe the food situation for a household. Please tell me if the statement was often true, sometimes true, or never true.

2. The first statement is: You and the other members of your household worried that food would run out before you got money to buy more. Was that often true, sometimes true, or never true in the past 12 months?
Often true ☐ Sometimes true ☐ Never true ☐
3. The food that you and the other members of your household bought just didn't last and there wasn't any money to get more. Was that often true, sometimes true, or never true in the past 12 months?
Often true ☐ Sometimes true ☐ Never true ☐
4. You and the other members of your household couldn't afford to eat balanced meals. In the past 12 months was that often true, sometimes true, or never true?
Often true ☐ Sometimes true ☐ Never true ☐

The next few statements may describe the food situation for households with children.

5. You and the other members of your household relied on only a few kinds of low-cost food to feed *Child Name* because you were running out of money to buy food. Was that often true, sometimes true, or never true in the past 12 months?
Often true ☐ Sometimes true ☐ Never true ☐

6. You and the other members of your household couldn't feed *Child Name* a balanced meal, because you couldn't afford it. Was that often true, sometimes true, or never true in the past 12 months?
Often true ☐ Sometimes true ☐ Never true ☐
7. *Child Name* was not eating enough because you and the other members of the household just couldn't afford enough food. Was that often, sometimes, or never true in the past yr?
Often true ☐ Sometimes true ☐ Never true ☐

The following few questions are about the food situation in the past 12 months for you or any other adults in your household.

8. In the past 12 months, since last [current month] did you or any other members of your household ever cut the size of your meals or skip meals because there wasn't enough money for food?
9. How often did this happen---almost every month, some months but not every month, or in only 1 or 2 months?
10. In the past 12 months, did you (personally) ever eat less than you felt you should because there wasn't enough money to buy food?
11. In the past 12 months, were you (personally) ever hungry but didn't eat because you couldn't afford enough food?
12. In the past 12 months, did you (personally) lose weight because you didn't have enough money for food?
13. In the past 12 months, did you and the other members of your household ever not eat for a whole day because there wasn't enough money for food?
14. How often did this happen---almost every month, some months but not every month, or in only 1 or 2 months?

Now, a few questions on the food experiences for children in your household

15. In the past 12 months, did you or the other members of your household ever cut the size of your meals because there wasn't enough money for food?
16. In the past 12 months, did you ever skip meals because there wasn't enough money for food?
17. How often did this happen---almost every month, some months but not every month, or in only 1 or 2 months?
18. In the past 12 months, were you ever hungry but you just couldn't afford more food?
19. In the past 12 months, did you ever not eat for a whole day because there wasn't enough money for food?

APPENDIX F

24-hour Recall a common dietary assessment tool

PLEASE LIST Every FOOD and DRINK You Ate Yesterday

UNIVERSITY OF SASKATCHEWAN

Name: _____ Age: _____ Date: _____

Time	Food Items	Type & Preparation	Amount	Brand Name or Where Bought
Morning				
Mid-morning				
Noon Meal				
Midday				
Evening Meal				
Before Bed				
EXAMPLE	CEREAL	CORN FLAKES	1 cup	Kellogs

Was this intake usual? Circle one: Yes No (if No, explain why not _____)
 Did you take any vitamins/minerals during this time? Circle one: Yes No (if Yes, list names: _____)

APPENDIX G

Components of Canada's Healthy Eating Index, range of scores and scoring criteria

Component	Range of scores	Scoring criteria
Adequacy†	0 to 60 points	
Total vegetables and fruit	0 to 10 points	Minimum: 0 Maximum: 4 to 10 servings*
Whole fruit	0 to 5 points	Minimum: 0 Maximum: 0.8 to 2.1 servings (21% of recommendation for total vegetables and fruit)*
Dark green and orange vegetables	0 to 5 points	Minimum: 0 Maximum: 0.8 to 2.1 servings (21% of recommendation for total vegetables and fruit)*
Total grain products	0 to 5 points	Minimum: 0 Maximum: 3 to 8 servings*
Whole grains	0 to 5 points	Minimum: 0 Maximum: 1.5 to 4 servings (50% of recommendation for total grain products)*
Milk and alternatives	0 to 10 points	Minimum: 0 Maximum: 2 to 4 servings*
Meat and alternatives	0 to 10 points	Minimum: 0 Maximum: 1 to 3 servings (75 to 225 grams)*
Unsaturated fats	0 to 10 points	Minimum: 0 Maximum: 30 to 45 grams*
Moderation‡	0 to 40 points	
Saturated fats	8 to 10 points 0 to 8 points	Minimum 7% to 10% of total energy intake 10% to maximum 15% of total energy intake
Sodium	8 to 10 points 0 to 8 points	Adequate intake to tolerable upper intake level Tolerable upper intake level to twice tolerable upper intake level
“Other food”	0 to 20 points	Minimum: 5% or less of total energy intake Maximum: 40% or more of total energy intake

* according to age and sex, as specified in *Canada's Food Guide*

† for adequacy components, 0 points for minimum or less, 5 or 10 for maximum or more, and proportional for amounts between minimum and maximum

‡ for moderation components, 10 or 20 points for minimum or less, 0 points for maximum or more, and proportional for amounts between minimum and maximum

Reference: Garriguet, D. (2009). *Diet Quality in Canada*.

APPENDIX H

Dietary reference intakes

Nutrients	Children 4-8yrs	Boys 9-13yrs	Girls 9-13yrs
Protein in g/kg/d (EAR)	0.76	0.76	0.76
Carbohydrate in g/d (EAR)	100	100	100
Fibre in g/d (AI)	25	31	26
Vitamin D in IU/d (EAR)	400	400	400
Folate (DFE) in DFE/d (EAR)	160	250	250
Vitamin B12 in mcg/d (EAR)	1.0	1.5	1.5
Calcium in mg/d (EAR)	800	1100	1100
Iron in mg/d (EAR)	4.1	5.9	5.7
Zinc in mg/d (EAR)	4.0	7.0	7.0
Sodium in mg/d (AI)	1200	1500	1500

Reference: Health Canada. (2010). *Dietary Reference Intakes Tables*